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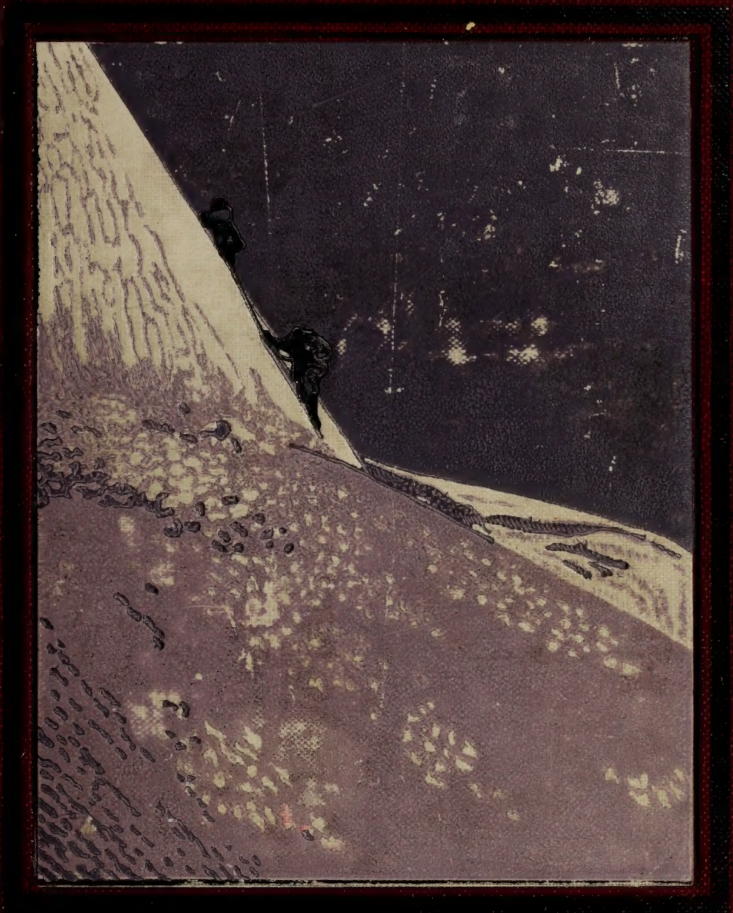

FANNY BULLOCK WORKMAN
AND
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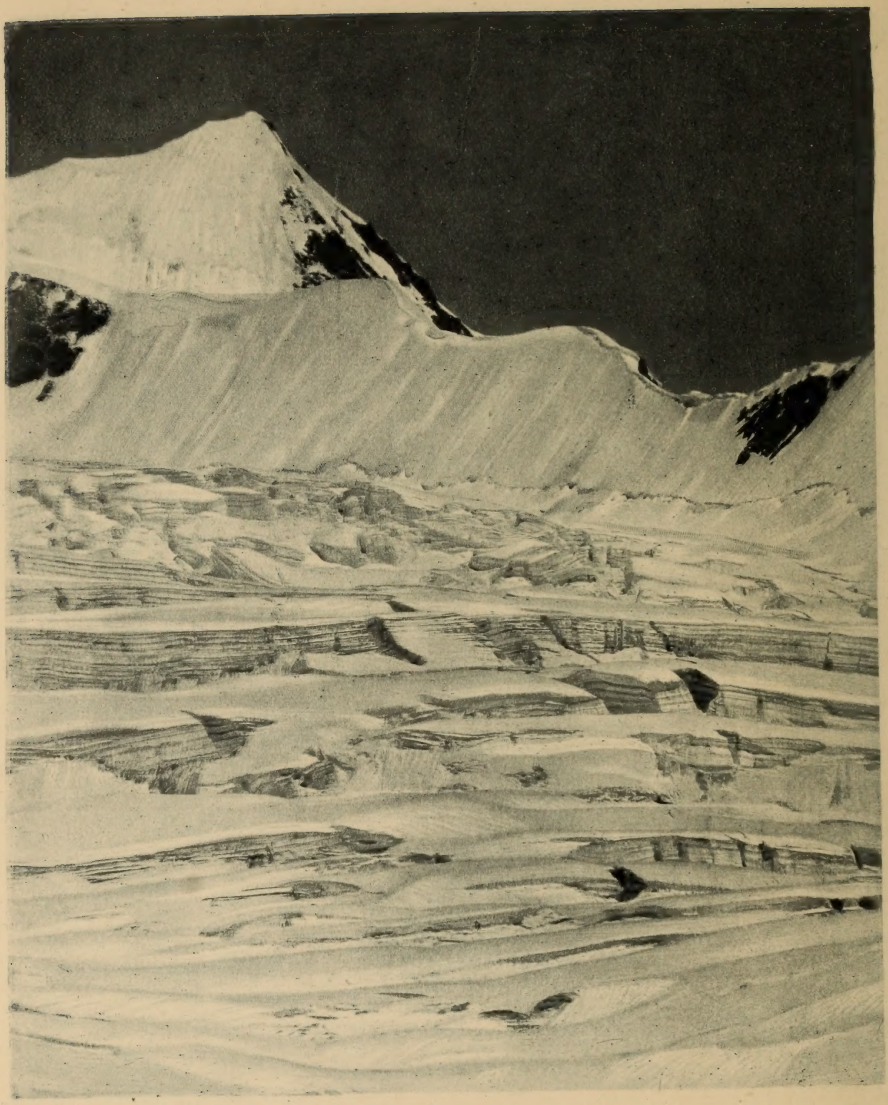

THE CALL OF THE SNOWY HISPAR

A NARRATIVE OF EXPLORATION AND MOUNTAINEERING ON THE NORTHERN FRONTIER OF INDIA

BY

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WITH AN APPENDIX BY

COUNT DR. CESARE CALCIATI

AND

DR. MATHIAS KONCZA

TWO MAPS AND ONE HUNDRED AND THIRTEEN ILLUSTRATIONS

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CHAPTER I

The Call of the Mountains—Preparations for Hispar Expedition—Over the Burzil by Night—Astor Pony-Caravan—View from Doian toward Hatto Pir—Nanga Parbat—Bunji Hospitality—Wind-swept Camp at Pertab Kadal.

With the conclusion of our Nun Kun Expedition in 1906 we thought we had finished our work of exploration among the higher Himalayas. We had borne the expense, the heat, the burden, the responsibilities and trials, and had been rewarded by the pleasures and successes, of five expeditions among its ice-clad peaks and glaciers, and had no intention of undertaking a sixth.

But we had breathed the atmosphere of that great mountain-world, had drunk of the swirling waters of its glaciers, and feasted our eyes on the incomparable beauty and majesty of its towering peaks, and, as time passed on, its charms asserted their power anew and called to us with irresistible, siren strains to return yet once again to those regions, the grandeur of which satisfies so fully the sense of the beautiful and sublime.

The great Hispar glacier borders regions we had explored on three expeditions. It had been included in the itinerary of two of them, but circumstances had prevented us from exploring it. We had ascended the Biafo glacier in 1899 to the Hispar Pass at the junction of the two glaciers, but were not prepared at that time to go farther. In 1903 we had scaled three virgin cols in its vicinity with a view to reaching it, but had found ourselves cut off from it on two of them by a glacier walled in on both sides by high precipices and by an impassable, intervening mountain-barrier, while from the third overhanging snow-cornices and steep, avalanche-swept ice-slopes rendered a descent to it impossible. The exploration of this glacier and of its large, unvisited tributaries would afford sufficient work for another expedition, and round out our observations of the region south of it. So, as our camp-outfit stored at Srinagar was still in a condition to withstand another season of hard usage, we concluded to answer the call and return to the snowy Hispar, attacking it this time from the side of Gilgit and Nagar.

To make an expedition in this direction, the per-

mission of the Government of India is required. A request for such permission was submitted through Colonel Sir Francis Younghusband, Resident in Kashmir, who very kindly took charge of the matter, obtained a favourable reply, and used his influence to assist us to make necessary arrangements. It gives us pleasure to express our appreciation of his kind assistance, which was of great value.

Next came the question of forwarding supplies. Owing to the lateness of the opening of the Burzil Pass—which usually is not considered open before the very last of May—and to the difficulty of obtaining adequate and reliable transport to Gilgit in the spring, the bulk of the supplies for ourselves and the Europeans of our party, as well as a large amount of rice for the coolies, had to be sent to Gilgit during the month of September 1907, to await our arrival the following June. Our friend, the late Major Bruce, the Political Agent at Gilgit, received the supplies and had them stored during the winter. He also very kindly arranged with the Mir of Nagar to provide transport for us and our supplies to Nagar, when we should arrive at Gilgit, and, further, to provide us during the summer with a corps of

sixty to seventy coolies to accompany us up the Hispar glacier, and, in addition to the sixty maunds of rice which had been forwarded from Srinagar, to have ready at Nagar a hundred and thirty-five maunds of ata for use as coolie-food.

In these and other ways Major Bruce smoothed the rugged path of our coming expedition. During the winter and spring we looked forward to meeting him at Gilgit the following June, but, by the inexorable decree of fate, on our arrival, instead of being able to greet and thank him in person for his valuable assistance, we had only the melancholy satisfaction of placing roses on his newly-made grave.

In 1892 Sir Martin Conway made a rapid ascent of the Hispar glacier, and sketched the salient points of its main stream with the plane table, but did not visit its branches. We proposed to examine it carefully, explore its hitherto unvisited large branches, to ascend any available cols or peaks for the purpose of observation, and, if possible, carry out a detailed survey of the whole basin. In order to accomplish this last, Mrs. Bullock Workman consulted M. Charles Rabot of Paris as to the possibility of obtaining a trained surveyor to

THE AUTHORS

accompany the expedition. He, in turn, consulted Professor J. Brunhes, Rector of the University of Fribourg, who recommended two of his pupils who had recently passed their Doctorate examination, Count Dr. Cesare Calciati and Dr. Mathias Koncza, who willingly availed themselves of this opportunity for a season's surveying in Himalaya. To the first two of the above-named gentlemen we take this occasion to express our obligation for their friendly assistance, and to the last two for their zealous co-operation in the work of the expedition, which resulted in the map that accompanies this volume.

Our trusted Italian guide, Cyprien Savoye, who had won our confidence by his intelligent and faithful services on two previous expeditions, was again engaged, and also three of our porters of 1906, Ferdinand Melike, Cesare Chenoz, and Adolphe Rey of Courmayeur. The roll of our Europeans was completed by Mr. A. Hogg of Srinagar, ex-police officer of Calcutta, our former agent in the Nun Kun Expedition, who met us in Srinagar, hale and hearty, ready to conduct our advance-caravan to Nagar. Early in May the topographers arrived,

and, a few days later, with Mr. Hogg in charge of our extra luggage, they set out for Gilgit and Nagar. On 23rd May Savoye and the porters reached Srinagar, and on 25th we started with them over the 232 miles of well-kept road to Gilgit.

We will not weary the reader with a detailed account of this route, which can be found in guide-books, and in the descriptions of other writers. We were detained ten days at Gurais by the illness of a member of the party, and did not reach the Burzil Pass till the afternoon of 14th June. Although so late in the season, the pass was far from being open, the path being still deeply buried under snow, and we were obliged to ascend the rough, pathless slopes of the Burzil gorge. Here the snow was not in the best possible condition, being in many places so thin that men and animals frequently broke through it, and floundered helpless among rocks and trunks of fallen trees bestrewing the earth beneath.

The ascent was all the more difficult, as we started from the Burzil Chowki at two o'clock A.M., so that the snow might be as hard as possible, and, in the darkness, could not see the dangerous spots till we

Gilgit road descending verdureless mountain-flank on north-east side of Burzil river.

were on them. On reaching the top of the pass at daybreak, after four hours of difficult and panting work, the snow became more solid. On the north side there was so much snow that we could leave the caravan path and vary the monotony of the descent by glissading. The pass is a most uninspiring one to mountaineers, and the best part of it is its end. The snow-covered portion was at that time ten to twelve miles long.

At Astor we engaged ponies to take us to Gilgit. Astor ponies are notoriously bad, and those now provided by the Tehsildar did not belie their reputation. They had had no grass to eat, and, apparently, but little else, since the snow fell six months previously, and they were the most sad-eyed, emaciated, galled, and spavined, lot of beasts we had seen since we left Astor five years before. Riding ponies there were none, so Mrs. Bullock Workman and Savoye, the only ones of the party who desired to ride, were obliged to make the best selection they could from the baggage-animals. Mrs. Bullock Workman's pony, at no time active in his movements, would stop short at the beginning of every small rise in the road,

and had to be well beaten from behind and pulled by a rope in front, before he could make up his mind to the further exertion needed to surmount the obstacle presented by the increase in the gradient.

At the end of each stage one of the several badly-galled ponies gave out and had to be discarded, and as only two new ones could be obtained in the whole distance to replace them, the rest had to be overloaded. It was a cruelty to compel animals in the condition in which these were to work, and, had others been available, we would have dismissed the whole lot; but as all our efforts to replace them with better ones failed, and as we must go forward, nothing remained but to push on with these.

The last three marches before Gilgit we had been told would be 'abominably hot' at this season, in fact, they would have to be made by night, if we wished to be in any degree comfortable. Although far too seasoned to Himalayan valley-travel to be alarmed by such prognostications, we held ourselves prepared to march by night, or adopt any other expedient that the event might show to be necessary. On the specified marches the

temperature proved to be decidedly cool, and on one of the indicated scorching stretches we had to put on unusually warm clothing to protect ourselves against the cold wind. We do not mean to imply that the information given us was not entirely correct and justified by the experience of those giving it. It certainly was. We only mention the matter as indicating our good fortune in having Nature thus smile upon us and make an exception to the general rule in our case.

One of the most interesting and impressive views on the route is that towards the Hatto Pir from the height above Doian. When one reaches the brow of the hill, the white road suddenly comes into view running sharply downward in zigzags for two miles, till it passes into a small oasis on the mountain-side, in which the Doian bungalow stands. Beyond this it winds down, down into a gorge enclosed by majestic, verdureless peaks, until lost to view in the turnings of the narrowing ravine. Still beyond, in the grey depths of distance, a good twelve miles from where one is standing, a bright green oasis is seen springing like a bit of life from the sandy valley into which the dusky Astor river

flows sullenly to join the Indus. The valley is a fine example of Nature's intricate scheme, and, while not a place to tarry in, like the Sind or Lolab, it has its grand aspects, that must impress the appreciative observer. Duke's guide says of this, 'The utter desolation must be seen to be appreciated.' There is indeed desolation, but no more than is to be found on many similar marches between the irrigation-born oases of Northern Kashmir.

Following up the Indus valley to Bunji, we were granted the view of Nanga Parbat so eulogised by those who have passed this way. The mountain, from where one stands at somewhat over 4000 feet, rises in precipices of rock and snow, a grand, broad massif, 22,000 feet higher into the air; and yet we must assert, though it may evoke criticism, that this is not the grandest view to be had of this great mountain. Try as one may, it is difficult to realise that 22,000 feet. The spread-out appearance of its various spires and pinnacles causing the actual summit to appear not greatly higher than the main mass, and the proportionally greater apparent size of the nearer mountains, forming the foreground of the picture, produce a dwarfing effect, that detracts

View of Nanga Parbat, 26,620 feet altitude, from Indus valley south of Bunji.

greatly from the impression which the really imposing front makes on the eye and mind. In our memory the most impressive view of Nanga Parbat, which massif we have seen from several different points, will remain the one we had from the Bannok La, over 16,000 feet, twenty-five miles to the east, from which we saw its immense, ice-covered, avalanche-scored crest looming in the afternoon sky several thousand feet above a semicircle of surrounding, snow-covered satellites.[1]

The dilapidated condition of our pony-caravan reached its acme at Bunji. The pony-walas said we must get five fresh ponies there, or send to Gilgit for a new set. Mrs. Bullock Workman's pony had long ceased to move except under compulsion, and she had in its place accepted Savoye's, which still retained some power of locomotion. She rode into Bunji in advance of the caravan to look up the Tehsildar. He was absent, as is often the case when a Tehsildar is wanted, so she dismounted and sat down on a log in front of his house to reflect. Soon above the chatter of the natives standing about she heard a cheery English voice, and, on

[1] *Vide* illustration opposite p. 382, *Ice-Bound Heights of the Mustagh.*

looking up, saw the bright face of a young officer, who asked if he might introduce himself.

'Certainly,' she replied. 'But we are in a dilemma. Our ponies are "dead beat," and we must join the rest of our party on the Hispar glacier as soon as possible.'

'Oh! that will be all right,' he said. 'Come to my bungalow, have breakfast and a good rest, and I will see whether a few new ponies cannot be got for you towards evening.'

'You are very kind,' she replied. 'We cannot stop. We must reach Pertab Bridge by four o'clock and go on towards Gilgit to-morrow. If the pony-walas unload now before ten o'clock they will never go on.'

He laughed. 'Why, that can all be done. Come to my bungalow till we arrange matters.'

Dr. Workman coming up with the caravan just then expressed his despair at its condition, which was also made light of by this happy young officer of the 5th Gurkhas. We could not resist his cheeriness, so we yielded. The weary animals were unloaded under the trees, and we followed the captain to his cozy, well-screened bungalow close by, while

the guide and porters, who were never unhappy over caravan troubles, assisted by the servants, made a raid on the apricot trees in the vicinity.

In the various Himalayan valleys we have traversed, fruit-trees, as well as, to a certain extent, growing crops, appear to be regarded as existing *pro bono publico*. Everywhere, both near and in villages, our coolies and servants have helped themselves freely to such fruits as came in their way without asking leave, as naturally as the ponies have turned aside to snatch up tempting tufts of herbage growing by the path. And no one has ever said them nay. Our guides and porters have never been backward in following the example thus set by their more primitive companions, and their efforts have, usually, been quite as successfully directed. There have been occasions on the march, when we have not disdained to avail ourselves of the results of such fruit-gathering, though, as a rule, we have found it more satisfactory to obtain our fruit-supply on a more business-like basis through the lambardars. The altruism of the Oriental in such matters contrasts strongly with the sentiment as to *meum et tuum* prevalent among Western populations.

After breakfast the captain ordered the Tehsildar's assistant to be brought in, who told us, as we feared, that no relief-ponies were available. Then our pony-walas were interviewed, who, after considerable discussion, agreed that, if we would provide grass for the ponies, they would start for Pertab Bridge at two o'clock, and, if more grass were carried along, would try to make a good march towards Gilgit the next day. This being settled, we whiled away the noon-hours most pleasantly under the captain's hospitable care. He forgot nothing conducive to our comfort, even to having our water-flasks filled with filtered water before we left, for the days were now become much hotter. The guide-book calls Bunji a hideous desert, but by us, owing to the generous hospitality of the British officer, who gave us freely of what he had, it is remembered as the brightest, most homelike spot on the road to Gilgit. One's views of most things in this world are shaped by one's experiences, and, doubtless, the writer of the sentiment expressed in the guide-book did not have as pleasant an experience at Bunji as we had.

An hour after leaving Bunji we encountered a

Oasis of Bunji as seen from gorge to south through which Gilgit road passes.

severe sand-storm, against which we had to struggle on for eight miles in soft desert-sand to Pertab Kadal, or Bridge. Here there was no wood for fires, no grass for the ponies—in fact, no soil, no water except the mud-laden water of the Indus, and only a boulder-strewn sand-flat on which to camp. With considerable difficulty the tents were pitched in the high wind, which still continued. The iron tent-pins, even when driven into the loose sand more than their length, would not hold for a moment, and the ropes had to be weighted with heavy stones.

At last camp was pitched, but comfort was not vouchsafed us. The strong wind continuing the whole night, blowing sand in upon us through every crevice, loosening the tent cords, and causing the canvas to flap in a most alarming manner, permitted us to obtain but little sleep.

About three o'clock the gale increased in force, and a strong gust tore away Dr. Workman's tent bodily from its fastenings, leaving him and his luggage without cover, exposed to the fury of the storm. As the night was dark, and it was impossible to light a lantern, he had to make the best of the

situation until daybreak, securing his belongings as well as possible in the darkness from the sand, which was driven in clouds by the wind. Altogether, this night was one of the most disagreeable we have passed in any camp, even in those on snow at high altitudes. Although the circumstances were quite different, the discomfort at this camp takes rank in our memory with that experienced in a camp in Sikhim ten years previously, where we were both obliged to occupy a small tent pitched in a severe storm on a rain-soaked hillside, and sit the night out on uncomfortable chairs, the legs of which sank deep into the water-saturated soil; and at Camp America at an altitude of 21,300 feet on the Nun Kun plateau, where we passed a night without companions, in small shelter tents, upon the snow, with a temperature falling to –4° Fahr., unable to sleep on account of the constant gasping for breath, induced by the rarity of the air at that high altitude. When Sayoye greeted us on breaking camp in the morning, he heartily assented to the remark, '*C'est mieux sur les glaciers.*'

CHAPTER II

Gilgit to Chalt—Sher Mohammed Khan—Unsatisfactory Transport of Poultry—Rakaposhi—A savage Region—Tongue of Hasanabad Glacier visited—Undrinkable Water—Arrival at Nagar—First Meeting with Mir—Mir pays ceremonious Visit—Arrangement of Business-Details.

Our impressions of the frontier military station of Gilgit were more favourable than we had been led by the descriptions given us of it to expect. The village, or town, is situated in a large and fertile oasis, covered for several square miles with waving grain at the time we passed through it. The Government officials occupy buildings on high land above the native portion. As has been stated, Major Bruce, the late Political Agent, had recently died, his temporary successor was away on tour, and nearly all the English officials were also absent, so that we saw nothing of the social life of the place. The two days we remained there were occupied in arranging for the forwarding of our mail, for the taking of readings of pressure and temperature by the Chief Hospital Assistant in charge of the meteoro-

logical department three times daily for us while absent, and in making other preparations necessary for the coming campaign.

On the two marches from Gilgit to Chalt, the prophecies as to heat were more than realised. There was not the least shade of any kind, and the sun burned like a live coal. In addition to the heat, three other scourges that had been mentioned to us were encountered, which conduced to destroy all bodily comfort, and effectually prevented sleep. These were flies, mosquitoes, and sand-flies, which attacked us with all the vigour and persistence we had previously noted in these mountain regions. The Chilas sand-fly is said to be worse than the Gilgit one, and, if this be true, we were fortunate in not being obliged to visit Chilas.

About noon of the second day, as we were marching over the crest of a hill, the oasis of Chalt came into view some distance below in a glaring, sandy valley. Shortly after the descent into the valley began, a man was seen to set fire to a large pile of burtsa and wood, and in a moment the whole was ablaze. The pony-wala explained that this was a signal to the Raja of Chalt that we were approach-

ing. Half an hour later a small bagh of apricot trees was reached, where we decided to take refuge from the singeing heat and have our tiffin. Here we were met by a messenger, who said that the Raja of Chalt and Sher Mahommed Khan, Assistant to the Political Agent, were waiting at a house a short distance beyond to receive us. He was told to say we would join them as soon as we had finished tiffin.

This was the first of a series of rather trying meals lasting till we left Nagar behind. In a shaded bagh in Suru one can sit in comfort and eat in peace, but here, whether in one's tent or under the trees, eating is quite a different thing. As soon as food is placed upon plates, myriads of flies, alert to assist at the repast, swarm down upon it and cover it with a black, buzzing mantle, while others do not omit to pay similar attention to the faces and hands of the unfortunate traveller, so that eating becomes a hasty scramble to get ahead of the flies in appropriating the food, mingled with active defensive movements to ward off the attacks of the crowd of winged assailants. After we had finished our none too satisfactory meal, we went on and soon came to the building on the outskirts of the village,

where Sher Mohammed Khan and the Raja were waiting.

The former, a tall, fine-looking Punjabi, speaking English well, greeted and welcomed us to Nagar in the name of the Mir, whose right-hand man he evidently was. He had been appointed to take charge of us and make all arrangements for transport and supplies, and, when we were on the glacier, to act as intermediary between us and the Mir, who spoke no English and but little Urdu. We are glad to be able to say he carried out his instructions faithfully, and rendered us most valuable assistance in many ways. He had at his tongue's end all the agreements made between Major Bruce and ourselves, and saw to it that they were performed punctually. He and the Raja accompanied us to a small grass-covered camping-ground above the village, saw that all our necessities were provided for, and regaled us with more apricots than it seemed possible the tiny oasis could supply in a season.

The previous evening at Nomal, as we knew that poultry would henceforth be difficult to obtain, four dozen chickens had been purchased to be taken along for food. As the heat was so great and we

feared they would die if exposed to the sun the next day, two coolies were engaged to take them to Chalt during the night. After we had paid for and fed them, they were thrust into two hemispherical baskets much too small to permit of each bird having a space as large as its own body, so that some of them had to stand or sit on the backs and shoulders of their companions. We remonstrated against such treatment of our newly acquired property, and demanded that more or larger baskets should be provided. The answer was that these two were the only ones to be had in the village.

As it seemed to be a question of Hobson's choice, we were obliged to permit the people to have their own way in the matter. But the outcome in the severe heat of thus crowding the chickens into such a confined space, where they were constantly jostling and treading on one another in their efforts to obtain a resting-place, was not uncertain. The next morning about ten o'clock we overtook one of the coolies, who evidently had not employed the night in travel in the interest of the chickens, on the bank of a muddy stream, where he was taking them out of the basket to permit them to drink. Of the

two dozen he had been carrying we saw seven dead ones taken out of that basket and four more were missing, which the coolie said had died and been thrown away. Those that were alive, when they realised that water, even though thick with mud, lay before them, buried their beaks to above the eyes in it, and drank as if they had never before had and never would have again an opportunity to slake their thirst. That evening, on arrival at Chalt, only a bare half of those four dozen vigorous chickens answered the roll call.

The next morning we were off early, our baggage carried by coolies, ponies, and donkeys—anything that could carry a load, for a large caravan is not easily made up in these parts. We were fortunate to have Sher Mohammed in command, for it is customary here to change coolies or ponies two or three times during a day's march, and in consequence delays and other unpleasant circumstances may occur; but he had transport ready whenever changes had to be made, and everything went smoothly and rapidly, though, owing to the frequent changes, somewhat to the detriment of our camp furniture.

North-west face of Rakaposhi, 25,550 feet, from Hunza river-valley
a short distance above Chalt.

A short distance beyond Chalt the peerless massif of Rakaposhi, 25,550 feet, called by the Hunza Nagar people Domani, first comes into view. Not a dozen miles away it bursts upon the eye, filling a long gap between lesser mountains, a glorious 18,000 feet of steep, broken snow-slopes, culminating in pointed icy summits. Colonel Burrard has said truly in his recent *Sketch of the Geography and Geology of the Himalaya Mountains*, that 'few summits are strictly peaks, the majority being rather combs or knobs rising out of prolonged ridges.' Rakaposhi, though not an exception to this rule, as first seen from the Chalt side appears to be a glittering peak of the first order.

From here to Hispar the whole region is wild and savage to the last degree. The valleys are narrow, and enclosed by vast walls of verdureless glacial débris, scarred and gullied by weather and water-action, above which rise shaggy, serrated, torn and riven peaks, their upper portions towering far into the domain of eternal snow. The bottoms of the valleys are occupied by alluvial terraces, or fans, washed out from the gorges between the mountains, intermingled with tali formed from the

glacial débris which has fallen down the high slopes. Through these terraces and tali the rivers have cut deep channels with ragged walls. Where water is available for irrigation, oases have been developed on the terraces, in which villages are situated. Some of these villages, clinging to the very edges of the water-gashed scarps on which they stand, appear ready to tumble into the river below. Others are graced by dismantled, crumbling fortifications, not very many years since peopled by fierce Nagar warriors, but now silent, hollow shells, valuable only as assets to the picturesque ensemble.

At Minapin the Minapin glacier is seen, bearing down on the hamlet in an ominous-looking tongue surmounted by a high ice-fall. Far up the glacier rises a beautiful white cone, the summit of Dirran, 23,500 feet, which a reconnaissance up the glacier showed to be connected with Domani by a long, snow-clad ridge. Farther on, great peaks with fearful precipices and snow-covered walls, truly awful in their inaccessible grandeur, flashed into view, and as we moved on, disappeared, not to be seen again on the circuitous route to Nagar.

We remained at Dadimal a day, in order to pay

North-east face of Rakaposhi from opening of Hasanabad nala into Hunza valley.

a visit to the tongue of the Hasanabad glacier, distant about six miles, to see whether any change had occurred in the position of the tongue since Mr. H. H. Hayden of the Indian Geological Survey observed and measured it in August 1906.[1] Early on the morning of 28th June, Dr. Workman, accompanied by a servant and coolie, set out for the glacier. On arrival at the Hasanabad nala he was met by the Wazir of Hunza and the Medical Officer of the Aliabad Dispensary near by, who presented the compliments of the Mir of Hunza, with a cordial invitation to the party to visit that capital. The day was warm, and after the walk of six miles in the sun, a large basket of juicy mulberries, which was sent as a present, proved most acceptable. The Wazir, Medical Officer, and a dozen attendants accompanied Dr. Workman to the tongue of the glacier.

It will be remembered that this glacier suddenly advanced several miles about 1903, as it is said to have done on a former occasion, having meanwhile receded again. Mr. Hayden's Station No. 1 was first visited, a huge granite boulder opposite the

[1] See *Records of the Geological Survey of India*, vol. xxxv. p. 135.

extremity of the tongue, with his inscription in black upon it as bright as if made the previous day. From here his Station No. 2, on the rock-face on the opposite side of the nala, could easily be seen, and the lettering on it read with the field-glass. A tripod was set up on the upper surface of the boulder for camera use and sighting. A line sighted from the top of this to Station 2 passed directly over the extremity of the tongue. Thus it was evident that, during the two years since Mr. Hayden's visit, the glacier had remained stationary. Also the tongue had not altered appreciably in appearance, judging from Mr. Hayden's photographs.

The steep talus leading up to Station 3 was ascended, and the spot, just above the water-canal, where the boulder which formed it had rested, was found, but the boulder itself had slid down the slope and lay embedded in sand below the canal, some fifty or sixty feet from its former position. The inspection having been completed, and several plates exposed, leave was taken of the friendly Wazir and his companions, and Dr. Workman returned to camp at Dadimal. At twelve-thirty, during the return-march, the sun-thermometer

Telephotograph of highest point of Rakaposhi, 25,550 feet, from Hunza river-valley above Chalt.
Deep shadows due to fact that exposure was made about seven o'clock a m.

registered 196.5° Fahr. From the region around the entrance of the Hasanabad nala a fine view is obtained of the north-eastern slopes of Rakaposhi.

At Dadimal, in addition to the heat and insects, a new source of discomfort presented itself. Soon after camp was pitched, when tea was served it was found to have a very disagreeable, bitter taste. The khansamah was summoned, and taxed with having used unclean water, as is frequently the case with Indian cooks. He denied this, and said the water was taken from a spring near by. Investigation developed the fact that all the water from here to beyond Nagar, over a distance of more than two days' march, was strongly impregnated with a salt, which, judging from its taste and effects, must be sulphate of soda, with perhaps an admixture of sulphate of magnesia. It may be imagined that not only the water itself, but also all food prepared with it, was most unpalatable and nauseous. After trying it for a curry, which our gustatory sense was unable to face, we gave up all further attempts to use it for cooking, and employed tinned provisions exclusively until beyond the zone where it existed.

For the next two days we learned what thirst

was, as we had not known it before in all the singeing heat. We shunned the water, however, to the last degree, preferring the pangs of thirst to its nauseating taste and unpleasant effects, and drank only as much of it as was necessary to sustain life. Over the whole district the surface was whitened by deposits of sulphur-salts, with which the earth was saturated, and all water tainted. The inhabitants did not appear to mind their presence in the latter, and the vegetation, in spite or in virtue of them, flourished exceedingly, in this respect resembling the luxuriant vine-growth on the lava-covered slopes of Mount Ætna.

From the route, a short distance before Nagar, the town of Hunza is seen across the river, rising in terraces upon a barren mountain-slant, its highest point crowned by the Mir's palace, like a medieval European citadel. Its lower part is hidden among the green foliage of a large, fertile oasis, which spreads downwards towards the river. Although Hunza and Nagar are separated only by the river and a few miles of territory, the people of the two places do not love one another, and in the days before they, after a sharp struggle, were embraced

Part of village of Niet, illustrating village-sites chosen by inhabitants of this region with view to defence.

within the limits of the Pax Britannica, when not engaged in warfare with a common enemy, they were continually quarrelling with, and making reprisals from each other.

As the Hispar glacier lies in the territory of the Mir of Nagar, who could supply the number of coolies needed for our Expedition, it was deemed advisable that all arrangements should be made with, and that all coolies should be supplied by him. Without doubt, the employment of any Hunza coolies would have given rise to dissension at once.

Having started at daylight, we reached Nagar at ten A.M., where we found no one waiting to receive us. We accordingly turned into a shady, grass-covered bagh, the property of the Mir, and sent a messenger to apprise Sher Mohammed, who had preceded us by two days, of our arrival. We were scarcely seated under the trees when he, accompanied by the Mir and some fifty followers, came hurrying down from the town above to meet us. Not being accustomed to arrange for those who begin their marches as early as we do, he had not expected us till towards evening, when he and

the Mir had planned to come out to meet us at some distance before Nagar and escort us into it. As it was, the meeting was not a particularly ceremonious one. The Mir, a medium-sized, slender, fair-haired, light-complexioned man, with brown eyes and aquiline nose, having been taken by surprise, was dressed in a decidedly *négligé* costume instead of in sheeny, silken robes, as one might imagine an Oriental potentate, living so far from civilisation and the influence of Western customs, to be attired. Greetings were exchanged, and questions as to our journey and immediate necessities were asked, after which, promising to return for a formal visit in the afternoon, the Mir and Sher Mohammed took their leave.

At four o'clock the Mir made his entry into our camp on a prancing horse decorated with flowers and tinsel, but any expectations of silken robes were again doomed to disappointment, for he wore a tightly-buttoned, faded, plum-coloured, European coat over loose, white, native trousers, a white linen shirt, standing collar with points turned down, narrow necktie, and his feet were encased in patent leather boots with brown cloth tops. He wore a

The Mir of Nagar at our camp in his private bagh. The men holding horse were afterwards with us as lambardars; the one at horse's head having charge of coolies on descent of Biafo glacier.

sword hanging from a handsomely-embroidered belt, and several decorations, among them that of C.I.E., to which, when asked about them, he pointed with evident pride.

Following him, the Wazir, or Prime Minister, led the two young princes of the House of Nagar, the youngest a pretty child with flashing black eyes and rich olive skin, very effectively dressed in a long gown of Kashmir silk. After all were seated within the circle of our tents, more than two hundred men of Nagar, many of them our future coolies, also seated themselves in two rows on the grass a short distance away.

The Mir brought a present of a sheep and a large ball of ghee, and the Memsahib in return gave the young princes mirrors, amulets, and coloured silk scarfs. Polite speeches were exchanged, the Mir saying that his people were to be entirely at our service, and that, if they did not do their duty they would be imprisoned and their lands would be confiscated. This sounded well, but, after years of Asiatic travel, we knew how to value such honeyed assurances of an Oriental. Had they been carried into effect, not a small number of Nagar coolies

would have passed a season in chains in prison, deprived of their privileges and property.

The court orchestra, seated in a line on the grass, now gave a concert, discoursing the weird strains one hears in Eastern lands, in which the tom-tom plays an important part, and to their accompaniment two men danced a frantic dance. The scene in the large, shady bagh was striking. Under the trees stood eight tents. In the centre of the space enclosed by these, the Mir, the baby prince clinging to his knees, sat talking animatedly to us, and at his left Sher Mohammed Khan interpreting rapidly. Just beyond stood the Wazir with the elder prince and several head-men, all dressed in their best toggery, and a little distance behind them, two long, semi-circular lines of villagers sitting on the grassy slant, silently taking in all that went on, while on the outskirts stood our sturdy guide and porters with the servants, watching with keen interest the to them novel proceedings.

The different participators in the drama were next photographed. We asked Sher Mohammed Khan whether it would be possible to get some women also as subjects for our cameras, but he said

Group at our camp at Nagar. From right to left: Sher Mohammed Khan, assistant to Political Agent at Gilgit; the Mir; his two sons; Wazir, his Prime Minister; Mrs. Bullock Workman.
Photo by Dr. Workman.

that could not be managed, for not a man in Nagar would permit his women to be seen, so we had to content ourselves with male types. In fact, we saw but few women while in that vicinity.

Business was next in order. The Mir is a shrewd business man. He knows the details of all that is done in his domain, and fixes the prices at which different commodities shall be sold, as well as the wages to be paid to coolies on all marches. It was arranged that seventy coolies were to take our personal baggage the two marches to Hispar, where our agent and the topographers had been established for three weeks ; that sixty others, under the direction of a lambardar assisted by a levy, the latter an irregular soldier of a frontier state who is paid by Government for his services, should ascend the glacier with us ; that these sixty were to be replaced by new men every two weeks, and that all coolies and lambardars were to be paid and fed by us. The proposition to change the coolies so often we did not approve of, as being disadvantageous to us, since by such change the services of coolies would be lost just as they were becoming somewhat trained to the particular work we required of them, and

sixty men, useless to us while coming from and returning to their homes, would have to be fed and paid during the time thus occupied, adding nearly thirty-three per cent. to the cost of employing them. As, however, the Mir seemed resolved to supply coolies only on these terms, objection was not pushed.

The sixty maunds of rice forwarded from Srinagar, and the hundred and thirty-five maunds of ata ordered of the Mir, had already been forwarded to our agent at Hispar, so we only had to take along certain supplies for ourselves, such as fowls, eggs, dried apricots, and sheep. The dried apricots of Nagar are very sweet and of excellent flavour, but only a limited quantity of them could be obtained, as the Mir said the inhabitants lived on them, seldom getting any meal or ata, and at this season the supply was about exhausted. Why the people did not have ata at their disposal we did not understand and did not like to ask the Mir, but the fact that he was able to supply us at a good price with one hundred and thirty-five maunds, 10,800 pounds, of it for use in feeding his coolies made us suspect that he reserved in his own hands the monopoly of that article of subsistence.

Men of Nagar seated on grass behind our camp, interested spectators of all that took place during Mir's visit.

We had previously ordered forty sheep for the expedition. A large number of sheep, each led by its owner on a cord, were brought forward, and forty of the best selected, taken over, paid for on the spot, and marked in blue for identification. The Nagar, like most Himalayan sheep, are small, and, probably, owing to active habits and scarcity of fodder, lean. Instead of paying, as in Baltistan, about two rupees per head, which is all they are worth, we were here obliged to pay five.

The sheep selected, the Mir inspected our loads, lifting several of them to satisfy himself that they were of proper weight and did not exceed the sixty pounds, which had been agreed upon as the weight for loads under ordinary conditions. Having expressed himself satisfied with their avoirdupois, as darkness was approaching and all necessary arrangements had been settled, His Highness, after repeatedly assuring us that he and all he had were to be ours while in his territory—as we by this time fully understood for a very substantial consideration—made his salaam, saying he would escort us out of Nagar in the morning, and rode away, followed by the multitude of his subjects who had

remained on the ground during the whole proceedings.

Feeling quite done up by the day's exertions, the morning march through the almost pathless region, the preparations for the further journey, and the afternoon work with its constant wagging of tongues—for the Mir, Sher Mohammed, and the Wazir had all talked at once for hours—we turned into our tents, blackened inside with swarms of flies which had taken shelter in them for the night, with the one thought, Oh, to escape from the bad water, the heat, and the flies, to the ice-cooled atmosphere of the glaciers.

Nagar types. Lambardar of Pisan, a Nagar village, on right

CHAPTER III

Nagar to Hispar—Wild and desolate Valley of Hispar River—Lambardar shows his Colours—Agent greets us at Hispar—The Village and its Inhabitants—Method of Altitude-Computation during Expedition—Hispar to Chokutens—Coolies prove refractory—To Makorum—Haigatum—Reconnaissance from Height above Haigatum Camp—Distributing Rations.

THE next morning, 30th June, we were off at daybreak. Having climbed the hill to the terrace on which the palace stands, we were met by the Mir and his suite, who accompanied us to the confines of the village, where they took their leave with wishes for a successful expedition. From this point a splendid, broad-topped, high snow-mountain was seen to the south-east, a huge canopy of gilded glory in the early sunlight, looming up a long distance off beyond the Hopar glacier. The Mir called it the Shenish Shish, which in the Nagar dialect means Golden Hill.

Ponies and donkeys were now left behind, only coolies being available for transport. The next two marches to Hispar, covering a distance, according to the Mir, of twenty-nine miles, though the map

makes it only eighteen, follow the course of the Hispar river through a narrow valley even wilder, more desolate, and desert, than those already traversed. We crossed the lower end of the Hopar glacier, and mounted the hillsides above the southern bank of the river to Huru, a small grazing ground, beyond which the path descends again to the river, which it follows to Hispar.

This valley is walled in on both sides by steep slants composed of alternate strata of alluvium, sand, gravel, and pebbles, interspersed with boulders of various sizes, to a height of one to two thousand feet above its bed, upon which are superimposed tali of similar materials fallen from elevations still higher, through the whole thickness of which the river has cut its way, leaving the ragged walls either vertical or descending to it in very sharp inclines. Much of this may be glacial deposit, but from the stratification it may be inferred that water has been also an active factor in its deposition. These walls are gashed at short intervals by deep ravines washed out by floods, and are eroded still further by rock and sand-avalanches, which occur frequently and fill the air with clouds of dust.

Large alluvial fan poured out from narrow mountain-gorge in background. Nagar river has cut a deep channel through it. The nearly perpendicular high wall thus formed above river eroded by weathering, frost, and water.

Where the valley widens out in places a series of terraces of similar formation exist. Many large, erratic boulders bestrew the valley and lie in the river, their tops, projecting above the surface, being polished by water action. The whole valley for fifteen miles below Hispar is a region of desolation, covered with the ruins resulting from its former contests with ice and water.

On these crumbling slants the narrow path, in many places obliterated and in others scarcely wide enough to set foot upon, winds up and down over verdureless spurs and along the edges of insecure precipices to Hispar. The angry river, which has played such sad havoc with its surroundings, has, fortunately, to be crossed only twice, the second time by a bridge composed of two long, slender planks without any railing. Not realising that we were quite accustomed to primitive methods of crossing rivers, the Mir, to our amusement, sent forward a massive, cotton rope, as thick as a man's arm, which, being stretched across the bridge and held taut by four men on either side, served as a balustrade for those crossing to hold on to.

Somewhat more than halfway to Hispar, we

camped on a sand-flat sparsely decked with grass. The lambardar was ordered to send out coolies to collect fuel from some brushwood which grew near by in sufficient quantity. Later the khansamah came to our tents and said the lambardar demanded of him a rupee for the wood provided, and also several days' wages for fifteen coolies whom we had never seen, but who, he asserted, had been sent out to repair the path. The lambardar was summoned, and told he must distinctly understand that we were not tiros in exploration, that we were not responsible for the construction or repair of the Mir's routes, and would not pay any one for such services. Further, that we were now in an uninhabited region, where fuel was free to any one who would gather it, that we would not pay him or his coolies one anna for collecting it, and the sooner he ceased such demands the better for him, as his conduct would be reported to the Mir. He was also told that he and the coolies were now in our service, receiving double the wages they earned, that their time belonged to us, and a part of their duties was to collect wood as required. No more was heard from him on these subjects.

Crossing Hispar river on bridge composed of two slender planks. Coolies on both sides holding thick cotton rope taut to serve as balustrade.

This was only one instance of extortion attempted in various ways on many occasions. The Nagar people evidently regarded us as lawful prey, and swooped down on us like a swarm of vultures from every side, determined to make the most of this rare opportunity to feather their nests. When we reached Hispar the next day, the agent poured into our ears stories of attempted extortion on him, that were most surprising. From this kind of dealing we must exempt both Sher Mohammed and the Mir, who, so far as we know, always acted in strict accordance with their agreements and promises; but on more than one occasion, to the detriment of our interests, their orders failed to be carried into effect through the disobedience of their subordinates.

The next morning at ten-thirty o'clock we reached Hispar. This village consists of a collection of stone and mud-houses with the usual flat roofs built upon a none too fertile alluvial fan, the component parts of which have at various times been poured out from the Yengutsa nala. The fan receives its fertilising water from the Yengutsa glacier, the tongue of which has encroached con-

siderably upon its southern and western portion. We were met by our agent, the ex-police officer, the village lambardar, and a majority of the male population of the place, in whose simple, monotonous life the arrival of such a caravan is as important an event and is made as much the occasion of holiday festivity as is the advent of a national or religious fête among the more artificial peoples of the West. The festive proceedings, however, were not of a very demonstrative order. There were no horse or motor races, no Olympic games, no merry-go-rounds with their clanging, ear-splitting music, no peripatetic roulette tables, no Punch and Judy, no Ferris Wheels, no penny-in-the-slot devices, no vending of quack nostrums or cheap confections, nor other simple amusements such as are considered fitting to amuse a Western holiday-multitude. The celebration here, more dignified and æsthetic, consisted in a cessation of all work, and a gathering of the villagers into silent groups, which absorbed themselves in rapt contemplation of every movement of the newcomers, till they had pitched and arranged their camp and retired within their tents.

Mr. Hogg, who, from his appearance, might have

been a Robinson Crusoe, had patiently stood guard over our supplies for three weeks, the greater part of the time alone, as the topographers had been occupied for more than two weeks upon the glacier higher up. He appeared much relieved by our coming, and said he was glad to see a white face again.

'And so you are going on,' he remarked. 'There are people in Gilgit, you know, who say you will never get up the glacier.' And then he related his experience with, and expressed his opinion of, the Hispar villagers, who were starving, owing to deficiency of crops for eight summers, and yet not a coolie could be trusted to carry a letter.

'Come,' we said, 'you take too dark a view of things, having stayed here so long alone. This is not the first time such prophecies have been made to us. Of course we are going on, and to the very top of the Hispar Pass, where we expect to find our footprints made nine years ago on our ascent to the pass from the Biafo glacier.'

'Wait till you have lived among these people a few weeks,' was his reply.

Hispar villagers were certainly an odd lot. When

offered a chance to get paid work, they seemed none too eager to avail themselves of the opportunity, and it was only after considerable persuasion that they could be induced to do work for us, even at the high wages we were paying, in accordance with our arrangement with the Mir. Perhaps in this respect they were only human, for a similar anomaly has been observed among the unemployed nearer home, who clamour so loudly for Government aid.

There seemed, truly, to be a great dearth of grain at Hispar, for when the topographers first arrived there and offered money to the coolies to carry their instruments, the latter handed it back, saying they could buy nothing with it, and would prefer a seer or two of ata instead. The topographers also reported they had seen the people go into the fields and eat grass. Perhaps, being unacquainted with the customs of the inhabitants, they may have been mistaken as to what herbs were employed for food. Later, when the coolies found they were to have both food and wages, they became abnormally keen on both, but remained indifferent to rendering services in return, in this respect differing in no degree from other Nagar coolies.

Hispar Village from point half-mile east towards Hispar glacier. At base of highest building in centre boiling-point and temperature-readings were taken for computation of altitude.

We remained two days at Hispar, to rearrange loads and prepare for the ascent of the glacier. Incidentally we looked at the tongue of the Hispar and Yengutsa glaciers, but did not give them the attention that would otherwise have been given, because Drs. Calciati and Koncza had observed and surveyed them in common with the rest of the region. Their report will appear elsewhere. Observation of these two tongues formed a part of the work done by Mr. Hayden for the Indian Geological Survey in 1906. His work in this region signalised the beginning of a newer era of methodical investigation of Himalayan glaciers. The systematic study of the movements and other phenomena of glaciers, which has for some years been carried on in Europe and America by glaciologists has opened a field full of interest to those engaged in it. When one considers the much wider field offered by the great Asiatic glaciers, it is earnestly to be hoped that the work so well begun in Kumaon, Lahaul, and Kashmir will be supplemented in years to come by that of other trained investigators, until in the not distant future which is bound to come in all things, the Himalayan glaciers will be made to yield their

manifold treasures to the eye of the expert, from whencesoever he may come.

Himalayan glacial investigation has also its utilitarian side in helping to avert dangerous débâcles, which occur when unsuspected or unwatched glacial lakes burst their barriers, and come pouring down in huge volumes of water, mud, and débris, spreading death and destruction in their course. In Hunza Nagar, as elsewhere, menace of this kind lurks in the ice-ramparts of many glaciers, and the more they are visited and reported upon, the greater will be the safety of its inhabitants.

As the future of mountaineering lies largely in Asia, so also does the scientific study of glaciers. If only a Himalayan love-philtre, like that of Brangäne, could be prepared and administered to the coolies to attract them to the glaciers, the path of future glaciologists would be rendered smoother and more certain.

In connection with the subject of the survey of the two glacial tongues near Hispar, it may be noted that Mr. Hayden's stations were marked in black, while those of our expedition, both here and higher on the Hispar glacier, were marked in red.

Face of rock on south side of extremity of Hispar tongue serving as first theodolite station. Inscription of Expedition in red.

Our camp was pitched near the edge of the Yengutsa moraine, twenty feet higher than the base of the highest building in the village. Our boiling-point readings for determining the altitude of Hispar were taken at the latter place. As during our expeditions to the Chogo Lungma and Nun Kun, we had readings at a lower Government station taken three times daily for us, while we were absent, and this time the station was at Gilgit. From here onward our altitudes were computed from boiling-point-readings compared with simultaneous ones at Gilgit. Should the altitude now assigned by the Indian Survey to Gilgit be at any time found to be inaccurate, the correction can easily be added to or substracted from our altitudes as given. The same would be true of our altitudes in the Chogo Lungma region computed in connection with readings at Skardo, and in the Nun Kun with those at Dras as base-stations. The altitude at the base of the above-named building in Hispar thus obtained is 10,758 feet.

On the morning of 4th July we left for the glacier, with sixty-five coolies in charge of a lambardar and a levy. We decided to keep to the left, or south,

bank as far as the Haigatum branch. Passing at a mile and a half the tongue of the glacier, which will be elsewhere referred to, we ascended a fairly good path over ancient lateral moraines for a distance of about four miles, when the majority of the coolies, who had been grumbling all the way, threw down their loads and refused to go farther, giving as a reason for such behaviour the weight of the loads, which they asserted were too heavy. This was, evidently, only a pretext, as many of the loads weighed only thirty-five pounds, instead of the sixty they were ordered and under obligation to carry. Three coolies were carrying only apologies for loads, one a hat-box, and another a primus stove in its box, both together not over ten pounds in weight.

It was noticeable here, as has almost invariably been the case, in our experience, in similar instances elsewhere, that those who were bearing the heaviest loads of sixty pounds or somewhat over, and who marched at the head of the column, were not the ones who began to complain. It was the rag, tag, and bobtail, of the caravan, the element which, previous to starting, sought out the lightest loads

and was detected in dividing loads into two parts, so as to carry as little as possible, that made the trouble. Sedition in the case of coolies, as in that of other bodies of unthinking persons, is a contagious affection, which, when once it breaks out, soon permeates the whole.

After long parleying between the mutineers and the lambardar, in which we took no part, they all continued on for two miles to a camping-place at Chokutens, where, depositing their loads, they sullenly withdrew some distance downward, saying they would return to Nagar, and left us to pitch camp as best we could. This behaviour caused us to recall the warning words of our agent at Hispar, and to have misgivings as to the outcome of the expedition. To have our belongings dumped down unceremoniously scarcely six miles from Hispar on the first day's march, and an easy march at that, a thing that had never before happened, was not an auspicious beginning to our glaciological investigations, and indicated a very unpromising spirit on the part of the coolies; but we did not show any concern nor attempt to call them back, considering it advisable to leave the management

of them entirely in the hands of the lambardar, who had been placed in charge of them by the Mir.

Paying no attention to their movements, we proceeded in a leisurely manner to open the loads and put up tents, telling the lambardar and levy they must manage the coolies. They followed them, and after a time succeeded in bringing them back, though without holding out any hope that they would go any farther. The next morning, however, they took up their loads and marched on. During the succeeding ten days they gave considerable trouble, mutinied once or twice daily, and received numerous good thrashings from the lambardar, who, contrary to our expectations, developed into quite an effective caravan-chef. Affairs continued thus until, in answer to an urgent demand on our part, the Mir sent strict orders to them to obey us and carry the stipulated loads. The altitude of the camp at Chokutens was 11,762 feet.

The second day's march took us over steep hillsides, over tali composed of rock-débris, over the tops of old moraines, and across the broad mountain-slant called Makorum, running steeply down to the Hispar between two branch-glaciers. We were

Some of the walls enclosing Garumbar glacier.

obliged to descend to the ice at the openings of these branches, and cross the uneven, detritus-covered surfaces of their junctions with the Hispar. These glaciers originate in exceedingly precipitous, serrated mountain-walls, which enclose them. All the mountain-barriers plunge sharply down to the glaciers here as elsewhere in the region. The clambering up and down the shaggy slopes, tali, and moraines, and over the still rougher débris-covered ice-hillocks on the glacier, was slow and fatiguing work; six or seven miles daily was all one could expect of the coolies.

We reached the east side of the Makorum glacier at four P.M., and found a small, grassy maidan about a hundred and fifty feet above the ice near its junction with the Hispar, which afforded a good camping-place. Its altitude was 13,123 feet. During this march we had constantly in view the opening into the Hispar of its first, large, northern branch, the Lak, with its huge, west, lateral moraine sweeping around in a splendid curve. The mountains enclosing the lower portion of the Lak rise so precipitously from it that they form what might be termed a gorge, through which it passes to join

the Hispar. Its surface at and above its junction with the Hispar is exceedingly rough and heavily covered with débris.

On the third day's march we crossed two more branch-glaciers, and reached Haigatum at two-fifteen P.M. Here, at an altitude of 13,671 feet, and about three hundred feet above the glacier, a smooth jagar, as the natives call a spot suitable for a camp, covered with grass and dwarf-willows was found, on which we camped. On the hillsides along this march dwarf-willows, adorned with a plentiful crop of catkins, grew luxuriantly. The dwarf-willow is distributed all over the Karakoram region on mountain-slants, maidans, ancient moraines, and on the edges of watercourses. Where the soil is fertile and well watered, it grows with a strong stem to a height of twelve to fifteen feet and more, diminishing in size as the soil becomes more barren and the altitude greater, till at 14,500 feet, where it ceases, it is a small shrub about a foot high. It is the last wood-growth seen on moraines. Its leaves are, proportionately to their width and actually, shorter than those of the ordinary willow.

Two hours after leaving Makorum, at an altitude

The junction of the Lak glacier, issuing from its gorge-like valley, with the Hispar. Note large, curving, lateral moraine on west side of Lak and hillock-covered surface of Hispar. Compare apex of peak on right with following illustration.

of about 13,300 feet, we met with the first névé-bed on the Hispar. This was really a large avalanche-bed, formed, probably, during the preceding winter or spring. It sloped from south to north, and was covered with longitudinal, rather ragged ridges, which bore on their crests nieve penitente-pinnacles in various stages of formation, many being fully developed and of conical or longitudinal shape. The long diameters of these oriented with the ridges from south to north.

A march of an hour and a half the next day brought us to the junction of the Haigatum glacier with the Hispar. Soon after starting, another névé-field was crossed, over the upper part of which avalanches fallen from above had passed. These avalanche-beds presented formations similar to those seen on that of the previous day. Rounding the shoulder of the spur bounding the Haigatum opening we came to a collection of dilapidated, stone huts, at some distance below which, between two moraines, a small, level, grassy spot facing the Haigatum glacier was found, sufficiently large for two tents. This we took possession of. Higher up were two similar places, on which the guide, porters,

and servants, pitched their tents. The coolies immediately set to work to repair the huts, and built others, so that in two or three hours the whole caravan was conveniently housed in a village of stone huts.

As the day was cloudless, and it was not yet ten o'clock, we left the servants to establish the camp, and ascended the rock-arête behind to a projecting ledge about eight hundred feet above the huts. Not far above the latter stood a substantial, stone cairn, evidently the one mentioned by Sir Martin Conway as built by his party at this place. It was searched for notes, but none were found, and we think Conway does not mention that any were deposited in it. Notes have been placed in every cairn we have built, both on glaciers and peaks, which those coming after us might use for reference, and care has been taken that no coolies should see this done, as they would almost certainly appropriate any box or jar containing notes, where cairns might be left within their reach. We have never found a record in any of a number of cairns we have come across. Possibly records may have been deposited in them and afterwards found and removed by the natives.

From the ledge a remarkably fine view was obtained of the Hispar glacier from near its lower end to the Hispar Pass twenty miles above, of the entrances of the great unexplored branches on the north side pouring their tortuous moraine-covered streams far into the main glacier, and of the towering, shattered summits rising behind them. Also to the south, directly beneath, of the whole course of the Haigatum glacier, its upper end of virgin whiteness, its lower banded by moraines, walled in on its south-east side by a glittering, snow-white barrier covered with ice-falls, rising at several points into massive, heavily corniced, white peaks. Near the south-west end of this barrier at its lowest point an exceedingly steep ice-wall with corniced brow descends to the Haigatum, obviously the so-called Nushik La, which, from its appearance, one could scarcely conceive of as a pass.

The wonderful scene spread before us was as clear as a printed page, and from it we could read and map out without hesitation the work of the coming weeks. As we looked up the Hispar glacier, the surface of which, up to this point, is a confused mass of débris-covered hillocks, and saw the slender

tongue of white ice, which here appears among them, broaden as it ascends until it sweeps across the glacier from side to side, Savoye remarked, ' A few hours more of moraine, and then all smooth ice to the pass.'

Then we turned our glasses to a sheer snow-wall on the south side of the Hispar, far above, between two peaks surmounted by an airy, reversed snow-cornice, which was recognised as the Alchori Col, where Mrs. Bullock Workman with the guides Petigax and Savoye had arrived early one morning some years before when seeking a passage to the Hispar. It made one shudder to see the very spot, on the edge of the delicate snow-ruffle, to which, held on the rope by the other two, each had crawled to have a glimpse down the two thousand feet of space that separated them from the Hispar.

At the upper end of the glacier, some distance north of the Hispar Pass, looming above the ice-falls which break down from its base to the glacier, appeared a pointed triangular snow-peak, which had attracted our notice nine years before from the Biafo glacier and the Hispar Pass, and again four years later, on our first ascent of the Col des Aiguilles

at the source of the Hoh glacier. Now, seeing it for the third time beckoning to us in all its untrodden beauty, we felt its charm anew, and, for the moment, forgetting we had come to this region to explore glaciers, remarked to Savoye, 'If possible, we must climb that peak,' to which he assented with alacrity.

Having completed our reconnaissance and taken photographs, we descended to camp, where the servants had everything in order. Our tents were prettily situated about fifty feet above the glacier, and protected from wind by the high moraine behind them. This was named Haigatum Camp. Its altitude was 14,372 feet. In the afternoon the levy was ordered to our tents to see if his knowledge of the region was equal to his professions. He was by no means a valiant-looking man, but he had all the way up boasted that he was well acquainted with the topography at this point.

We said to him: 'You have heard of the Nushik La, have you not?'

He replied: 'Yes, I have heard that there is such a pass.'

We continued: 'Now look out over the glacier

at that long snow-wall and tell us where the pass is.'

He looked up and down over the Haigatum mountain-barrier, and, after a few moments, said he did not feel quite sure.

'Tell us where you think it lies.'

He examined the barrier again in a hesitating manner, and finally confessed he did not know.

We said: 'That is sufficient. You may go. We will find out for ourselves.'

So much for the levy, whose vaunted topographical knowledge proved to be as slight as his capacity for controlling the coolies, for which latter purpose he was employed.

As the coolies had been supplied with food for three days at Hispar, rations were first served out to them at this camp. The distribution of these during the expedition was entrusted to the porters. To simplify this procedure, two tin measures had been provided, one holding accurately one seer, or two pounds, of rice, and the other one seer of ata. One seer of either was the daily ration for each coolie. The two measures differed somewhat in size. Shortly after the distribution began, a porter

came to Dr. Workman's tent and said the coolies objected to the measures as not being correct. Taking a new Salter's spring-scale, Dr. Workman went to the place where the assembled coolies surrounded the porters and grain sacks, called the lambardar, the levy, and two of the coolies, who had refused to take their rations, to be witnesses, and weighed one measure filled with ata and the other with rice before their eyes. When all had examined the scale and found that the measures gave them full weight, they announced the fact to the rest, who received the information with grunts of satisfaction. The accuracy of the measures was never again disputed. It was characteristic of these coolies that though, left to themselves, they would never carry a full load, nor, when sent to fetch wood, bring even half a load, and would loot grain on every available occasion, they would exact the last atom of rations and the last farthing of wages.

CHAPTER IV

Character of Hispar Mountains—Nushik La—Previous Crossing and Unsuccessful Attempts—Ascent of Ice-Wall East of the Nushik—Start at two A.M.—Steep Slopes—Reach Mamelon at 18,000 Feet—Nushik La impassable—Changes in Himalayan Passes and Glaciers—Nieve Penitente—Formation of Crest of Ice-Wall—Ascent of Triple Cornice Peak—Arduous Descent in soft Snow—Search for Kunjut Peaks—Return to Haigatum Camp—Ridges on Névé-Slopes—Retreat of Haigatum Glacier as shown by Lateral Moraines.

THE mountains enclosing the Hispar and its branches are characterised by their extreme steepness and greatly broken surfaces, being seamed by gorges and ravines at all altitudes. In addition, their higher parts and the entire slopes of those on the south-east side of the Haigatum and south side of the Hispar are heavily coated with ice and snow, which settle into hanging glaciers and séracked ice-falls on their flanks, and festoon their ridges and apices with great, stratified cornices, sometimes even double and triple in character. These, breaking away, frequently give rise to avalanches, which sweep the whole mountain-flanks down to and over a considerable portion of the glaciers. Hence the

So-called Nushik La on south wall and near head of Haigatum glacier, from ridge above Haigatum Camp, four and a half miles distant. Note cornice along whole edge of Nushik and of wall above, and steep, dangerous slopes leading upward. Our ascent was made at extreme left of wall here shown to mamelon partly seen at left edge of skyline.

mountains are not only difficult, in most cases impossible, but also very dangerous to climb or even to approach.

Opposite Haigatum Camp two twin-peaks raised their heads from the south-east wall of the Haigatum glacier to an altitude of over 21,000 feet. The wall beneath them fell away to the glacier in an almost unbroken series of ice-cascades. If either of these peaks could be ascended, an extensive and, topographically, important view could be obtained. We remained a day in camp while Savoye and Rey made a reconnaissance to find out what the chances of an ascent might be. They succeeded in scaling the cascaded wall to a snow and glacier-covered plateau, at about 20,000 feet between the two peaks, but here found the faces of both peaks to rise so precipitously and their tops to be so fringed with cornices that further progress was impossible.

Such is the nature of the mountains surrounding the Nushik La or Nushik Col, which, as already said, is the lowest point on the south-east wall of the Haigatum glacier near its head.

On 9th July, with light tents and provisions for two days carried by fifteen coolies, we ascended the

Haigatum glacier and crossed it to a snow-plateau east of the base of the slope leading to the Nushik Col, as near the mountain-wall as was judged to be safe from avalanches. Here we camped at 15,072 feet, sending the coolies down to Haigatum Camp with orders to return the next day at noon.

Considerable interest attaches to the Nushik La from the fact that for many years it has been spoken of and written about as affording a passage between Baltistan and Nagar *via* the Kero Lungma. The natives are said even to have taken animals over it in former days. But when such testimony as exists is sifted, there appears to be no record within the memory of living man of any one having crossed it except four members of Sir Martin Conway's party in 1892. Even as far back as 1861, when Colonel Godwin-Austen ascended the Kero Lungma to the top of this so-called pass, and, finding it corniced as at present, was obliged to return, nothing definite appears to have been known about it. Later, Major Cunningham followed in Colonel Godwin-Austen's track, and reached also the summit of the pass or col, but, finding it corniced and a steep ice-wall beneath it, prudently retraced his steps

without attempting to descend towards Nagar. Dr. A. Neve reports trying to reach Nagar from Arandu by way of the Nushik in 1896, but was unable to get over it.

Early in July 1892 Major the Hon. C. G. Bruce and Mr. O. Eckenstein, and, twelve days later, Mathias Zurbriggen and Mr. Roundebush with some coolies succeeded with considerable difficulty in crossing the pass and descended the Kero Lungma to Arandu. These are the only four Europeans known to have crossed it. Their accounts make it evident that this in 1892 was not a route available for loaded coolies or caravans.

Our interest in the pass having been awakened by the endeavours we had made during our expeditions to the Chogo Lungma, Hoh Lumba, and Alchori regions in 1902 and 1903 to find passages over the mountain-barriers from these regions to the Hispar glacier, including an attempt to cross the Nushik La itself, which had been frustrated by the refusal of the Basha coolies to go, and being now on the ground, we determined to avail ourselves of the opportunity offered to examine it.

During our careful study through field-glasses of

the steep, avalanche-scored ice-wall beneath the Nushik La two days previously from the ledge above Haigatum Camp, we had seen, what was here even more apparent, that it was so difficult and dangerous on account of its gradient, the character of the snow covering it, and of its exposure to avalanches which might at any moment be caused by the breaking away of the cornice that fringed its whole sky-line, that no one but a foolhardy person reckless of his life would attempt to scale it.

Further to the east, the slopes, though more broken by faults, schrunds, and séracs, and, in places, apparently steeper and also overtopped by stratified cornices, appeared to offer a better passage to a snow-mamelon high above the Nushik La on the brow of the wall. After another careful examination, we concluded to try to ascend the wall to this mamelon, which would give a clear view of the Nushik La. To accomplish this with a reasonable regard to safety it would be necessary to start very early in order to get down again by noon, by which time the daily cannonade of avalanches started in.

At one A.M. Savoye called us. We jumped out of our sleeping sacks, and, in an hour, after a meal of

coffee and biscuit, the party started, roped in two caravans of three persons each, the leaders carrying candle-lanterns. No coolies accompanied us, provisions and instruments being taken by the different members. Savoye led upwards, without haste, but, in spite of the darkness, with great certainty, though the route up the broken surface was necessarily a circuitous one, never once being obliged to return upon the track, thus showing how thoroughly he had studied the ground the previous afternoon.

For the first two and a half hours the exceeding steepness of the gradient was the chief thing observable, as darkness veiled all surrounding objects. That we nearly circumambulated two great séracbeds became evident by the winding of the course pursued. Glimpses were caught here and there of great, curving ice-pinnacles, appearing harmless and stolid in their nocturnal environment, which a few hours hence, when burning sunlight had been switched on them, would lose their stolid appearance, and, their snowy crests, softening under the heat thus applied, might break away and plunge down the slants, bringing woe to any one or thing standing in their path.

As the first glimmer of dawn flickered across the long scarps we had climbed and the still abrupter ones to come, we sat down for breakfast in the broad bed of an avalanche that had fallen the previous day. Though no one said so, every one felt and knew that the others felt, this was a spot to be avoided altogether on the return.

Dawn is beautiful in the plains when heralded by the swish and twitter of innumerable song-birds; lovelier still at the bases of the hills, when shafts of dark violet flare up the spurs, turning to pale mauve and pink as they dart upward into the advancing light; most beautiful of all, higher yet above the abodes of man, beyond even the voice of the high-flying chough, where, as the curtain of darkness which has held the upper world in its inky grip is uplifted, glaciers, arêtes, and peaks, hitherto unseen, are revealed, spreading out on all sides in the calm, simple magnificence of ante-sunrise lighting.

For the next 1560 feet we were busily engaged in finding a path through sérac-areas, ascending very steep névé-slopes, and rushing certain passages under ice-walls overhanging deep schrunds and

On edge of bergschrund separating ice-shelf from shattered perpendicular face of mamelon.

fringed with insecure cornices. There was, perhaps, no immediate danger here at that early hour, but later, on the descent, every part of this section would be full of threat, and the prospect of returning through it was disquieting.

Attempts were made to measure three of the steepest slopes with Abney's level, which is scaled to 60°, but it was found, as in the cases of those of Mount Nieve Penitente and D41 in the Nun Kun region, that the scale was not sufficiently high to measure them accurately. Judging by the excess shown by the index over the scale markings, as well as by a comparison with the perpendicular, they were at least 70°, and perhaps somewhat over. Eckenstein's estimate as given by Conway of the gradients of the slopes he ascended farther west on the Nushik La wall was at most 52½°.

At last a long, gently-ascending terrace was reached, directly beneath the great mamelon we had been aiming for. The terrace, which was an ice-shelf covered with névé, was about thirty feet wide, and was separated from a perpendicular ice-wall beneath the mamelon by a wide, radiating, starfish-shaped bergschrund of unknown depth. From the

brow of the mamelon projected a huge overhanging snow-ruffle, resembling a colossal expanded cobra's hood.

After crossing one of the radiations of the schrund on an insecure snow-bridge, and after considerable step-cutting, we stood under the farther edge of the ice-wall, here somewhat diminished in height and free from cornices, but by the narrowing of the shelf brought directly over another ice-precipice falling sheer for several hundred feet. Savoye attacked the wall at this point with his axe, making a steep stairway, up which we all clambered to the upper surface of the lower part of the mamelon. Ascending this upper surface some fifty or more feet, we reached the top of the great névé-mound at a height of 18,000 feet, east of the Nushik La and overtopping it by at least 1200 feet.

The latter was now in full view below, and we could judge of its dangerous condition even better than when looking up at it from the glacier. With its continuous snow-cornice running from end to end of its top, and the sharply descending avalanche-channelled ice-wall beneath, it reproduced exactly the conditions existing on the Bolucho Col, which,

Ascending ice-wall of mamelon at point directly over a re-entrant angle of ice-precipice, the stratified upper edge of which is seen at right.

by great good luck, we succeeded in crossing with a coolie-caravan without serious accident in 1903, though it might not be again, in years, in a condition that would permit of a second passage.[1]

It was evident that the route apparently taken by Eckenstein and Bruce in 1892, as described by Conway,[2] was now in 1908 impassable. That they got through alive can only be accounted for on the supposition that the conditions on the wall have changed for the worse since that time, a perfectly reasonable supposition. Zurbriggen chose a safer and more practicable route. His route up the wall starting in considerably east of our starting-point must have crossed our route about halfway from the glacier to the top of the ridge, and have come out at a snow-mound on the upper edge, which could be seen to the west of and several hundred feet below our mamelon, not far from the Nushik La. That coolies were taken over any part of this wall is remarkable, for we feel positive that not one of our Nagar coolies could have been induced to follow us loaded up the appallingly steep and dangerous

[1] Vide *Ice-Bound Heights of the Mustagh*, pp. 336-348.

[2] Vide *Climbing and Exploration in the Karakoram Himalayas*, pp. 350-360.

face of the wall, as we found it. At any rate, the Nushik La cannot be regarded as a pass in the proper sense available for travellers with coolie-caravans. If it can be called a pass at all, it is only a mountaineer's pass. Its difficulty, however, lies wholly on the Haigatum side, for the descent to the Kero Lungma is easy enough.

Great changes are known to have taken place in Himalayan passes. The Mustagh pass readily occurs as an example. A trade caravan route into Central Asia is said to have formerly existed over this pass, but it fell into disuse on account of the increasing snow, and the pass had become thoroughly a mountaineer's pass when Sir Francis Younghusband crossed it from China in 1887. Such it has remained since that time, and such it was found by Ferber, who ascended it from Baltistan in 1904, quite impracticable for loaded coolies. It is not surprising that such changes should result from the operation of the mighty natural forces always at work in great mountain-regions, where snow, water, and wind, are constantly building up, washing out, and tearing down, with a rapidity unknown at lower levels.

On summit of mamelon at 18,000 feet. Surface covered with nieve penitente.

In our own experience, variation in existing conditions has been observed on revisiting certain places. Cornices have been found where previously none existed, and changes in the structure of glaciers have taken place. When we made the first ascent of Koser Gunge in 1899, no snow was met with on its rock-face towards the Shigar valley, till an altitude of over 19,000 feet was reached. In 1902, at the same time in the summer, the whole Shigar side was covered with snow down to about 16,000 feet. In 1899 we found the Biafo glacier just above its lowest ice-fall seamed by great transverse crevasses, which ran across the whole glacier from one side to the other. On descending this glacier in 1908, in returning from the Hispar, the crevasses at this point were shorter and ran diagonally instead of transversely to the axis of the glacier. In 1902 the side of the Chogo Lungma glacier, at a point opposite the entrance of a large branch descending sharply from high mountains, lay at a considerable distance from a large lateral moraine. In 1903, at the same point, the glacier was found pushed over hard against the moraine, the ice overtopping it, undoubtedly by the increased

pressure exerted by the branch in consequence of a large increment of snow in its upper parts during the preceding stormy summer and winter.

On the ascent of the wall we encountered several avalanche-beds covered with nieve penitente of the pyramidal type, the pyramids being eighteen to twenty-four inches high, and orienting with the slope and courses of the avalanches from east to west. The whole upper surface of the mamelon and that of the névé for a long distance above it was scalloped into moderate-sized but very perfectly formed nieve penitente, many of the pyramids having hoods or fringes of ice that sparkled like brilliants in the sunlight. The pinnacles were arranged in parallel rows, that swept around with the curves of the surface orienting in various directions.

We stopped for some time on the mamelon, taking observations and photographs and studying the view, which was grand in the highest degree, including the unscalable rock-precipices of the giants towering above the north side of the Hispar and branches, while towards Baltistan we recognised several old friends, and among them Haramosh,

View of upper surface of mamelon from shoulder south-east of and above it, looking north-west. Behind mamelon is the black north-west wall of Haigatum glacier. On skyline in centre is high peak of west wall of Lak glacier.

lifting their crests above the Kero and Chogo Lungma glaciers. North-east, along the face of the great snow-wall we were standing on, the most bizarre and remarkable snow-sculpturing we had ever beheld presented itself, though we afterwards found it equalled in strangeness by that on other portions of the same wall higher up on the Hispar.

The crest of the wall rises at short intervals into elevations or peaks, composed of vast accumulations of snow and ice smoothly rounded on the east or rear side, but breaking down into perpendicular ice-precipices towards the Haigatum glacier; both they and the brow of the wall between them are scalloped out into most fantastic shapes, cleft by great chasms, and crowned with huge stratified cornices curling over with curves of marvellous complexity, which neither description nor photography can give any adequate idea of.

The first of these peaks rose half a mile away to a height of about a thousand feet above where we stood, and from the névé-field behind the mamelon three rounded shoulders with a small terrace between the two lowest led up to it, the faces of

each shoulder breaking down towards the Haigatum in manner described. We regarded the cornices decorating the edges of these latter with some apprehension as to what influence they might exercise on our descent, for the downward route lay directly under them. The top of the peak was also corniced, but looked as if it might be accessible under free use of the axe. So we started upward again to try for it. After a pretty climb of an hour and three-quarters up the crisp névé-slopes, we reached a narrow shelf about forty feet from the extreme summit, directly under a tremendous cornice, which curved round above us like the lower fold of a gigantic turban. One end of the shelf ran directly into this overhanging fold, but the other end passed around to a point where the cornice no longer overhung, but slanted back at a steep angle. This was the only point from which the actual summit could possibly be reached, but it was at best a most ticklish place to attack.

Savoye proposed all should stop here while he made an examination to see whether it was safe to proceed. The porter next him unroped, in order to give him a greater length of cord and more freedom

Triple Cornice Peak, showing formations of wind-driven snow, 19,000 feet.

of movement, and the rest of us, crowded together on the shelf under the cornice, made ourselves as secure as possible, in case he should fall. He now attacked the steep face vigorously with axe and feet, and, as it was composed of rather soft snow, soon disappeared from sight, sending down showers of loose snow upon us as he dislodged it from his path. Much of the snow, instead of remaining on the shelf, slid off over its edge, and could be heard coursing down the face of the precipice below with an unpleasantly suggestive slithering sound. This continued for fifteen or twenty minutes, and, with the constant blows of his axe, told us he was using all his strength to conquer the last bit of the cone.

Finally a shout came to haul in the rope, and in another minute he bounded down to us looking like a veritable snow-man, so encased was he in white. He reported having got within twelve feet of the summit, when he was stopped by three ice-cornices rising one above another like steps, the last running back in a flat slab of ice. He said cutting a path through these would take two hours or more, and he questioned whether it would be wise to spend

so much time for the short distance to be gained, with the descent before us, which would hourly become more dangerous. We consulted our watches, and found it was ten o'clock. It did not take much discussion to decide that it was scarcely worth the candle to pierce cornices for two hours without gaining any real advantage, only to risk being buried on the descent by others that were threatening to overwhelm the downward path.

Having taken readings, from which calculations give the peak an altitude of 19,000 feet, and photographs, and having named it Triple Cornice Peak, we started down, although we would have liked to remain several hours longer for study and observation. We descended as quickly as possible, spurred on by the fact that the sun's heat had already softened the snow so much that below the brow of the wall we sank into it to the knees and often to the waist with every step, as we threaded our way around and over the sérac and avalanche-beds, and down the steep slants. Snow-bridges that were hard and safe on the ascent were now treacherous, and the greatest care was required in crossing them. Avalanches, according to their volume, began to

Standing on narrow shelf beneath ice-cornice at summit of Triple Cornice Peak. Shelf ends in precipice just behind. In opposite direction shelf leads to point where cornice flattens into three as described in text.

sizzle and boom around us, creating a nervous tension that impelled us to hurry on without pause, until camp was reached shortly after noon, where we could again breathe freely.

Descending the sharpest slopes in the softened snow was not child's play. It was impossible to follow in the tracks of the leader, which ended two or three feet below where his feet struck the surface, without letting oneself go freely, and the momentum thus obtained caused one to sink in deeper still, and often to lose one's balance on the insecure foothold where one landed, and to flounder for a time helpless in the snow. It was also with difficulty that one foot could be lifted above the surface to take the next plunge, and a place had to be trodden out to enable this to be done. If one avoided the tracks already made and struck out in a new line, one's feet and limbs were liable to become so firmly impacted in the snow into which they sank as to require assistance in loosening them so that they could be drawn out again. Under such circumstances the descent at these points was arduous and fatiguing.

On this ascent we did not neglect to look for the

so-called Kunjut peaks Nos. 1 and 2, the latter of which is placed on the Indian Survey map north of the Nushik La, at the head of the ' Churi ' glacier, the Pumarikish of our map. Until the mamelon at 18,000 feet was reached, we could see to the north of the Hispar only the serrated tops, apparently high, of the mountains rising immediately from the Pumarikish, Khatumburumbun, and Sekambaris branches; but above this point, higher peaks behind them came into view, increasing in number as we ascended, till at the summit of Triple Cornice Peak a line of high peaks was seen extending along the northern horizon, from beyond the Kanibasar branch on the east to the western barrier of the Lak glacier.

Which of the complicated assemblage of peaks to the north might be Kunjut No. 2, 24,580 feet, we could not determine with certainty. We saw only the tops of some of them, which were visible in the spaces between others in front. The important factor of the distances of the various peaks from us was unknown, and from their positions could not well be estimated. Besides, we were not sure that the highest peak of all, the one in question, might

View north from Triple Cornice Peak across north-west wall of Haigatum glacier upon mountains north of Hispar glacier. Pumarikish glacier at left centre descends from these mountains. Above its head is peak near position given on survey map to Kunjut No. 2. On right, Khatumburumbun glacier descends into Hispar.

not be concealed from view by some nearer high elevation. The line in this direction appeared to culminate in a sharp spire behind the head of the Pumarikish glacier, practically in the position assigned on the Survey map to Kunjut No. 2, but this seemed too small and pointed to attract attention at the distance from which the Kunjut peaks were seen and fixed. Also a more distant and more massive peak on the west side of the Lak glacier put in a claim for consideration, though farther from the position given by the Survey. It seemed, however, certain, that a great, white mass, rising far above any surrounding elevation, at the east end of the line, was Kunjut No. 1, 25,460 feet, the highest of the Kunjut peaks. Its position as regarded the Hispar or any branch, on account of the distance, as well as of our want of knowledge at this time of the topography of the upper Hispar region, could not be determined, but its bearing from this point was about what it ought to be from its place on the Survey map. We hoped to be able to ascend some other height on the south Hispar wall to make farther observations, but this hope proved futile, for at no other point was it

safe to approach even the base of the wall, on account of the danger from avalanches, much less to scale any of its impossible scarps. Kunjut 1 will be mentioned again in connection with the Kanibasar branch.

At two o'clock the coolies arrived from below. Camp was struck, and we left at three for Haigatum Camp. On the downward march, as we were discussing the experiences of the day, every moment of which had been replete with interest, Savoye expressed the opinion of an expert in the remark, he was glad that climb was safely finished, and he should not care to repeat it, for he had not been easy in his mind from one o'clock that morning till the return to camp at noon. There are certain obstacles and dangers one feels one can cope with, probably with success, on mountain ascents, and these one willingly faces, but the Himalayan avalanche is an ever-threatening foe, often striking from unseen and unexpected quarters, against the attack of which, though ever on one's guard, one can never feel a sense of security. He who travels in the snow-clad Himalaya, over its battlegrounds of avalanches, must be prepared, as on the battle-

View north-east from Triple Cornice Peak across mouth of Haigatum glacier and the Hispar. High peak at right is Kunjut No. 1, 25,460 feet, east of head of Kanibasar glacier. Two rounded peaks in centre stand at head of Jutmaru glacier. Sekambaris glacier, on left, falls toward Hispar but does not join it, having receded a considerable distance up the slope. Note débris-covered, broken surface of Hispar and narrow tongue of white ice ending just below junction of Haigatum with Hispar.

fields of war, to say 'Kismet,' and take what may come.

By our examination of the Nushik La from the opposite ridge, from the glacier at its base, and from the heights above it, as well as by our ascent of Triple Cornice Peak, we think we can claim to have made fairly thorough work of it, and brought it and its surroundings up to date, and are justified in saying that, until great change for the better occurs, it cannot be regarded as a passage available for travellers' and explorers' caravans.

The névé-slopes on and above the Haigatum glacier were largely covered with parallel ridges separated by hollows, which, without exception, oriented in the direction of the incline of the slopes they stood on, and as different slopes inclined in different directions, so the ridges oriented to all points of the compass. Where slopes converged to a point, the ridges also converged towards the central line, and where they diverged the ridges did the same. The snow of these ridges was granular and denser than that of the hollows between them. This formation, also extensively found on the Hispar, Jutmaru, and Kanibasar glaciers, was

formed, apparently, both by wind and, on the steeper slopes, by subsidence of the snow; but in both cases, the direction in which the ridges ran coincided with that of the slope they surmounted.

The present level of the west side of the Haigatum glacier for a mile or more above its junction with the Hispar is much lower than it has been in the past. The glacier appears to have been retreating at intervals for a long time; just how long is not apparent, but four distinct lateral moraines run along the hillside above it, one below another, all of them covered with dwarf willows and other vegetation. Our tents stood in a furrow between the third and fourth moraines, about fifty feet above the glacier. A fifth moraine adjoining the ice was in process of formation, and had attained a considerable size. The blackened and detritus-laden side of the glacier rose directly over the moraine, and sent down constant showers of earth, stones, and boulders, upon it, from the abundant accumulation with which the upper surface and edge of the ice were loaded. Opposite the camp the glacier-wall, after slanting outward and downward

Telephotograph of rock-needle rising from north wall of Hispar above opening of Sekambaris nala.

from its upper edge for about half its height, changed its direction and slanted backward behind the moraine into a subglacial lake. Here the excreted detritus after striking the top of the moraine often rolled backward between the moraine and the ice and fell with sullen splash into the lake.

CHAPTER V

Across the Hispar to North Bank—Value of a Cook—The Jutmaru Glacier, Surface, Scenery, Camp on, Descent of—Coolie-Tobacco lost in Crevasse—Messengers from the Mir—Border-Lakes—Erection of Cairn—Wood-Line Camp—Khansamah overtaken near Wood-Line Camp—His Characteristics.

On 12th July we left Haigatum Camp, and crossed the lower part of Haigatum glacier diagonally to the point where its eastern edge joins the Hispar. In doing this we had to traverse five large, longitudinal, median moraines, the tops of which rose about sixty feet above the lowest portion of the hollows between them. Beyond the last moraine lay the tongue of white ice previously referred to, here quite narrow, which we followed for half a mile, and then struck across the hillock-area coming from the Jutmaru and Kanibasar branches. Here the hillocks were large and symmetrical, and arranged in lines. Some of them were at least 250 feet high, and were heavily covered with moraine-material from their bases to their apices. Many of them showed denuded crests with perpendicular ice-wall

Earth-pyramids on steep slope above Hispar glacier, west of Jutmaru junction. Slope appears greatly flattened, being photographed from point directly above. Beyond pyramids is Hispar surface.

beneath on one side, and between them lay many lakes later to be described.

A rough scramble of over two hours across these brought us to the north or right bank of the Hispar, which was followed up over rough, ancient, lateral moraines and broken hillsides. Here two series of earth-pyramids were seen standing upon steep, ragged, water-washed cliffs of clay, mingled with rock-fragments. Some of these pyramids were capped with stones. The sides of the glacier ran at some distance from the mountain-wall, and rose high above the glacial bed, a broken and tumbled mass of gigantic hillocks. The moraine-covered interval between it and the mountain-wall was of the roughest imaginable description.

At three P.M. we came to a small, alluvial fan about 300 feet above the glacier, between the mountain-flank and a large, primary moraine. This was covered with grass, and was divided into two portions by a stream. The coolies refused to go beyond this point. As it was a good place for a camp, probably better than any that could be found beyond, and was not far below the entrance of the Jutmaru glacier, the first north branch of the

Hispar above the Haigatum and our next objective, no attempt was made to induce them to go farther. The crests of the hills above this camp were covered with immense boulders, some of them balanced, and needing only the application of slight force to send them crashing down the intervening slope to the glacier.

As the supply of coolie-rations was fast diminishing, ten coolies were despatched from here to Hispar for more, thus weakening our force, and necessitating shorter marches in order to bring up what had to be left behind when we first started.

The next morning the whole caravan moved up in an hour to the junction of the Jutmaru with the Hispar. Here the khansamah, all servants except the bearer, the levy, majority of the coolies, goats, sheep, and fowls, and greater part of our luggage, were left with orders to camp and the following day to cross the Jutmaru junction, ascend three hours on the Hispar bank beyond, and await our arrival.

It is our custom when making especial explorations in higher parts lasting some days to dispense with the luxury of a cook, and the ordinary camp-

impedimenta, contenting ourselves with only absolute necessities, and consequently reducing the number of coolies to the lowest limit, on the principle that the more coolies there are the more chance of trouble and the less chance of accomplishing the end in view. Many years ago a friend remarked, 'The main thing in married life is to keep the oven going and never be without a cook.' Without doubt, under ordinary conditions this remark contains a large element of truth, but in Himalayan tent-housekeeping we have found it advisable to drop the cook on occasion, though never the oven, which in the shape of the primus has always been taken with us, and helped to make life endurable at the highest points.

All necessary arrangements being completed, we started with Savoye, three porters, one servant, the lambardar, and twenty coolies, to explore the Jutmaru. Getting on the glacier was not easy. A high, ragged, crumbling wall of earthy material, sand, and rocks, thrown promiscuously in together, which seemed to be neither talus nor proper moraine, but more resembled a vast refuse-heap, had to be traversed. The descent of it to the glacier was

abrupt, and one's foothold on it none too secure. This being passed, we clambered into a chaos of ice-ridges, pinnacles, and hillocks, heavily covered with detritus, and even more complicated in arrangement than the broken surface of the Hispar itself, up, down, and over which the caravan slowly wound its way for about three miles, until it shaded off into smoother median moraine, and then into white ice.

We were now on virgin ground which, like the other branches, was unexplored and unsurveyed. From here till near its head the surface of the glacier was divided into four great, longitudinal ridges, much bestrewn with moraine-material, and one broad band of smooth ice. There were few crevasses, and the gradient was easy, so that the ascent was not difficult. The surface was dotted for miles with countless thousands of glacier-tables, the tops of which consisted of granite boulders. Large portions of its central third were covered with nieve penitente, the spaces between the pinnacles of which were occupied by pools of clear water with perpendicular walls, at the bottom of each of which was a thin layer of finely divided

Steep face of high, lateral moraine at junction of the Jutmaru with Hispar glacier, which had to be descended to reach the Jutmaru. Dangerous to traverse on account of the unstable condition of surface.

earthy material, sand, gravel, or thin fragments of shale. Many pinnacles over six feet high were formed from the shafts of glacier-tables, from which the tops had fallen off.

The scenery on this glacier is grand in the highest degree. We found we were amply repaid at every point for the time and exertion devoted to reaching it. The glacier is surrounded by lofty, boldly and picturesquely formed rock and snow-mountains, graced by hanging glaciers and savage splintered ice-falls clinging to their abrupt flanks with so precarious a hold that it seemed as if the slightest earth-tremor would send them flying in resistless avalanches to the glacier beneath.

At its northern end the main glacier divides into two snow-filled basins, one leading north-west and the other north-east. The abrupt, projecting mountain-wall separating them from each other is surmounted by two majestic peaks, their clubbed apices festooned with scalloped, weird cornices resembling three-headed cobras. One was forever finding again and again yalis, cobras, and other grotesque figures of South-Indian temple-architecture, colossal in size, yet delicately modelled in snow,

on these extraordinary, fantastic peaks surrounding the Hispar.

We reached the point of the dividing wall in the afternoon, and, after considerable tramping around in soft, deep snow, found at last a smooth, sloping snow-surface on the edge of a large, glacial border-lake at an altitude of 15,384 feet, where we camped. The coolies and servants took up their quarters a little distance away on a moraine, the top of which was just peering above the snow. With the great black walls of rock rising in front, in the shadow of which the water of the lake at our feet looked sombre and pitiless in the deepening twilight, and with the white pall of snow and ice on all other sides, the place impressed the mind deeply with a sense of its indescribable grandeur, as well as of the insignificance of a human life and human endeavour in the procession of the great activities of Nature's plan.

The next morning we started out early with guide and porters to explore the north-east basin, which is considerably larger than the other. This is walled in by mountains of the same character as those enclosing the other parts of the glacier.

Camp on névé, at 15,387 feet, at junction of two heads of Jutmaru glacier. Portion of west head at left.

Portion of south-east wall of east head of Jutmaru glacier.

We made a circuit of the basin, going up one side and returning by the other. At its extremity it divides into two smaller basins or fans which from a distance appear to meet behind a projecting mountain, making, as it were, an island of it, but a nearer examination from the side showed the projecting mountain-mass to be connected with the main ridge behind by a high, slender arête, which separated the fans.

During the three days passed on the Jutmaru we looked everywhere for a practicable peak or col that might be ascended to obtain a wider view of this splendid region, but in vain. The mountain-walls were utterly inaccessible, with the exception of one acclivity leading to a col that overlooked a district of no importance.

Reaching our tents again at noon, we struck camp and descended the upper third of the glacier to an opening on its east bank, where a short, sharply falling branch enters. In order to get to the bank we had to pass through a high, narrow, V-shaped passage between great séracs of black, débris-laden ice constituting the side of the glacier, and a steep talus of rock-fragments fallen from the walls above.

Just after the first three of the party had passed through the interval, and as the other three were about to enter it, a large sérac above broke away and crashed down in fragments directly across the path, blocking it to a height of about four feet. The escape for either party was a narrow one. From this it may be seen that avalanches and crevasses are not the only dangers to be guarded against. We have had a number of escapes as narrow as this from falling rocks, from the giving way of séracs, and from sudden floods, or *swas*, that have taught the moral of keeping a sharp look-out for all such events.

Soon after this we came to a large, lateral moraine over 150 feet high, on scaling which we found a level maidan about 500 feet in diameter behind it, through which ran a stream of clear water, coming partly from a glacier above, and partly from a lake occupying one-third the area of the maidan. The maidan had recently been under water, as the sun-baked, crackled surface testified. Here we camped late in the afternoon at an altitude of 15,046 feet.

When the coolies came up shortly after our arrival, one young fellow shaking with fear was

Furrow between e lge of Jutmaru glacier and mountain-wall, which had to be followed for over half a mile. Just after three of party had passed beneath large sérac at right it fell directly across path between them and rest coming behind. Ice of edge abundantly covered with rock-débris.

led up by the lambardar, who said the man had allowed a sack of coolie-tobacco he was carrying to fall into a crevasse, where it had disappeared from view. We replied, ' Very well, that is the end of coolie-tobacco, so far as we are concerned, for the season, for that is all there is. If the coolies cannot take any better care than that of the tobacco provided for them they can go without.' The lambardar and coolie went away. Two hours later the coolie reappeared, bringing the sack of tobacco, thoroughly soaked. It appeared that the lambardar, perceiving how little we concerned ourselves about the matter, and that through this accident the coolies would be wholly deprived of the opportunity to solace themselves with tobacco, sent away four of them with a rope to try to recover the sack. After clambering about inside the crevasse for some time, they succeeded in rescuing from the water at its bottom the weed, which they valued more highly than their daily rations.

Toward evening a levy and a coolie arrived, sent by the Mir to find out where we were. They brought with them as a present from his Highness two dead chickens, and a small basket containing

a quart of unripe plums. The chickens, which had, without question, left Nagar alive, had died of rough treatment and starvation, it being the custom here to carry them by the feet, head downward, and certainly no native would ever trouble himself to feed them. A fowl that has to make a journey of more than two days has therefore a very small chance of reaching its destination alive. After delivery of these delicacies, the messengers asked for several days' rations for the return to Hispar, which request, to prevent them from sharing the fate of the chickens, was acceded to. It is not necessary to say they got considerably more from such exchange of courtesies than we did.

The next morning we continued on down the glacier. To get on smooth ice we were obliged to traverse a sérac-belt similar to the one crossed the previous day. We kept near the east side, and, after five hours, approached the broken hillock-zone. Here we again left the glacier and descended in the interval between it and its east bank, which from this point to the Hispar was wider than above. The side of the glacier, split up into towering, jagged masses, ran in a straight line rising high

Avalanche falling on wall of east head of Jutmaru glacier.

Séracs on east edge of Jutmaru glacier. Mountains behind form north wall of two heads of glacier.

above its bed. The ice itself, as well as many crevasses in it, was filled with mud, stones, and boulders, and bore upon its surface vast quantities of the same, which were constantly being discharged, often in cartloads, upon the lateral moraines below. At one place we saw three avalanches of débris dislodged within five minutes, which, falling one on another, increased the height of the moraine beneath by two feet.

Getting over the ground here was no child's play. The bed of the gully through which we had to force our way was covered with an irregular accumulation of boulders and moraine-stuff, not any too safe for one's limbs at best. We passed around two large, exceedingly picturesque border-lakes, enclosed by high glacier-walls on one side and the mountain-slants on the other. These were dotted with ice-floes and diversified by bays, promontories, and islands. Into their water the débris from the glacier, loosened from its bed by melting, every now and again splashed sullenly and sank out of sight. At half-past one P.M. the junction of this branch with the Hispar was reached. The two broken streams of ice, each at a considerable

distance from its bank, come together at a right angle, forming a great re-entrant angle, neither stream appearing to crowd back and displace the other to any extent at the point of contact. The appearance here is quite different from that at the lower, or west side of the opening, where the Jutmaru, having between these two points crowded the whole Hispar stream over strongly to the south, turns in a great curve and forces itself in bodily between the latter and the north bank.

A short distance above this junction a stone-cairn was built on the crest of a high, primary moraine, and a tin with account of what had been accomplished up to this time was deposited in it. We then ascended in the space between the high ice-walls of the northern edge of the glacier and the mountain-side and over moraines. At one place we crossed what had been the bed either of a lake recently drained, or of a *swas*, where the rocks and ice were coated ankle-deep with soft mud, which clung tenaciously to our boots in clumps, so that after a few steps in it our feet presented the appearance of camels' feet. A mile and a half above the cairn we came to a sandy place sparsely sprinkled with

Re-entrant angle on east or upper side of junction of Jutmaru with Hispar, formed at meeting-point of the two streams. On right of centre is Jutmaru stream with morainic deposit at its base moving from north to south. On left is Hispar stream with heavier lateral moraine moving from east to west.

grass, where we camped at an altitude of 14,529 feet. This was named Wood-Line Camp, as near here all wood, or more properly, bush-growth, ceased, the willows being only about a foot high.

This camp was situated under the protecting shoulder of a high, steep mountain-slope covered with rocks discharged by a large, hanging glacier ending on its brow. The edge of the ice on the sky-line above could be seen bearing large boulders, several of which during the afternoon having become loosened came crashing down the slope, bringing avalanches of rock and great clouds of dust with them. These were turned aside by the shoulder above the camp, and landed only a short distance away. The camping place, which had been chosen in the area of protection afforded by the shoulder with reference to the occurrence of such events, was the only safe spot beneath the slope, and one did not feel any too secure even here. If the mud-coated place below had served as the bed of a *swas*, the *swas* evidently had descended from that upper hanging glacier. The topographical conformation here was a typical one for the occurrence of this phenomenon. Wood-Line Camp was

159 feet higher than our camp on the Haigatum glacier, so that the glacier falling only that amount between the two camps ran for a distance of about eight miles practically level.

It will be remembered the khansamah had been left three days previously at the lower edge of the Jutmaru opening with orders to cross the junction of that glacier with the Hispar and await our arrival. When we came up we found him established alone just below the rock-strewn slant above described near the edge of the cliff. Near by were the live stock and loads of coolie-ata piled up and covered with empty gunny sacks, presumably to protect them from the sun, as there was no danger of rain, and such covering would not protect them from the thief.

When we asked him where the other servants were, he in his customary, listless manner replied they were behind with the coolies, who had gone down for the balance of the luggage and would return that evening. He also said that a sack of ata and one of rice had been stolen, and that a coolie from Hispar had arrived with a hundred eggs many of which were broken when delivered to

Building stone-cairn on north bank of Hispar twenty-two and half miles above extremity of tongue, between Jutmaru and Kanibasar branches. Rocks are being handed through line of coolies to lambardar, who is placing them on cairn. High perpendicular glacier-edge well seen. Also well-marked hillock-formation of glacier-surface, even at this distance above tongue of glacier. *Vide* Chapter X.

him. The two bearers, who being Punjabis were not on the best of terms with the Kashmiri khansamah, later said the lambardar told them the khansamah had sold the grain to the coolies for sixteen rupees. We never learned whether he did or not, but probably he was quite as capable of so doing as the other two and the lambardar were of lying. Knowing the unreliability of native testimony we made no attempt to probe the matter, though in the circumstances the disappearance of the two sacks of grain represented a real loss, which might make all the difference between success and failure in investigations immediately before us in which coolie-assistance was concerned.

Our old Kashmiri khansamah of five previous expeditions, though a consummate rascal, had shown himself to be a man of some natural wit as well as of considerable ability. The present khansamah also possessed one or two admirable qualities, but cooking was not one of them, for he would not cook. We say would not, because on three occasions in four months he did prepare us a good meal, at least roasted a fowl well, and the last night before returning to Srinagar he treated us to a really

delicious custard pudding, so we suppose, possibly, he could cook if he wished.

He was powerless with coolies and pony-walas. When they loitered on the road, he sat down and smoked his long pipe, which he always carried with him, until they chose to move on. We had a strong suspicion that he had bought his excellent chits in the bazaar, and that his real profession was that of bhisti, for, when we camped in dry, dusty places, he sprinkled the ground about the tents with the hand of an expert. We do not know what he could do on snow-mountains, for we never took him above our base-camps, but on moraines that tried the bodies and souls of others, when not engaged in a symposium with his pipe, he was nimbler than a goat, and the aplomb with which he glissaded a five hundred foot sand-slope, one day, caused us to think he had mistaken his calling, and that under Savoye's instruction he might become a mountaineer.

CHAPTER VI

High Ice-Pyramid—The Kanibasar Junction—Lower Base Camp—Southern Wall of Hispar—Difference in Coolie-Standard for Wood-Load when bringing and using it—A *Swas* descends near Camp—Ascent of Kanibasar Glacier—Crossing Glacier-Stream on frozen Slush—An uncomfortable Camp—Bad Weather causes Return to Base Camp—Payment of Coolies—Reconnaissance on Hispar—Second Ascent of Kanibasar—Kunjut Peak No. 1—Upper Base Camp.

We were now above the wood-line, approaching the snow-covered banks of the glacier. To do any exploration higher up, it was necessary to establish a base-camp. Although it was the middle of July, the few spots, where even small camping-places existed, were mostly still hidden under snow. It was evident that a place must be found on the next march, if at all.

We struck out directly from Wood-Line Camp over the lateral moraine towards the centre of the glacier, and, for an hour, had to struggle through the broken, detritus-covered hillock-area coming from the next large branch above. This passed, we came to a band of smoother, white ice which was followed up. The gradient here was considerably

steeper than below. Many ice-tables and nieve penitente-pyramids resulting from the modelling of the ice-shafts from which the rock-tops had slid off were seen. At one place, standing entirely alone, except for two similar smaller formations, in the centre of a smooth ice-field, a sharp quadrilateral pyramid of dense, greenish ice covered with grey sand, thirty-three feet high, was met with. This pyramid was, without question, due to the primary deposition of a quantity of sand on the glacier, which had protected the ice beneath it from the heat of sun and air, that had melted away the glacial surface around, thus placing it in the category of débris-conditioned nieve penitente described at length in *Zeitschrift für Gletscherkunde*, Band III., pp. 261-263, 1909, and in *Peaks and Glaciers of Nun Kun*, by the Authors, 1909, pp. 192-194.

Toward noon the opening of the second, large, northern branch above the Haigatum glacier was reached. This was called by our native attendants, both from Nagar and Hispar, the Kanibasar. The first, large, north branch above the Haigatum which we had already explored they called the Jutmaru. On the Survey map and on Sir Martin Conway's

Alchori Col, 17,662 feet, lying directly above Hispar opposite Kanibasar junction. Col is lowest depression in ridge connecting the two peaks. Behind it Alchori glacier falls away to south to join Kero Lungma. Above col portion of eastern Alchori barrier is seen joining left Hispar peak.

map the latter is shown as the Kanibasar, and the former is left unnamed. The designations as we have given them were used both by the coolies with us and those with Drs. Calciati and Koncza. The pronunciation of the name Jutmaru is, perhaps, open to question. To us it sounded as spelled by us. To Drs. Calciati and Koncza it sounded like Jutm-â-ū without the r, both vowels being pronounced as separate syllables. The addition of the r has the advantage in English of preventing the pronunciation of the two vowels as a diphthong.

Crossing a fine, curving sweep of median moraine that came down with the Kanibasar stream, and an area of séracs at its junction with the Hispar, we headed for a high, lateral moraine under a cliff, which was free from snow, and was, indeed, the only spot in the neighbourhood that was bare. As we approached the side of the glacier we found access to the moraine barred by a large lake between it and the ice. Although the ice here was greatly broken, the only thing to be done was to find a way through it around the lake to the upper end of the latter in order to get upon the moraine. Leaving

one porter here to watch our movements and follow with the caravan when it should arrive, we continued on, and after an hour succeeded in reaching the bank. Here after ascending the high moraine we came to a spot on its broad upper surface, where two places had, apparently, been levelled off for tents, and two stone-bases were found, which looked as if they had been intended for the bases of cairns.

As this is the spot indicated on Sir Martin Conway's map as the site of his 'Snowfield Camp' there seemed to be little question that here was where his camp stood. Leaving this spot to be occupied by Savoye and the porters, we ourselves took possession of a place a little farther up on the moraine, where it was wider, and would better accommodate the camp impedimenta. Two tent-terraces, one behind the other, were levelled off, and a stone-platform made in a hollow near by, on which to stack the grain-sacks so as to keep them from contact with the wet ground. This camp was called Lower Base Camp. It served us as a base for the next two weeks, till the snow was sufficiently melted to permit of another camp being made still higher. Conway gives the altitude of his camp

Lower Base Camp, 15,354 feet, on north bank of Hispar. South wall of Hispar in background. Haigatum enters Hispar beneath last of the three high peaks, its white ice ending directly over ridge of tent on right.

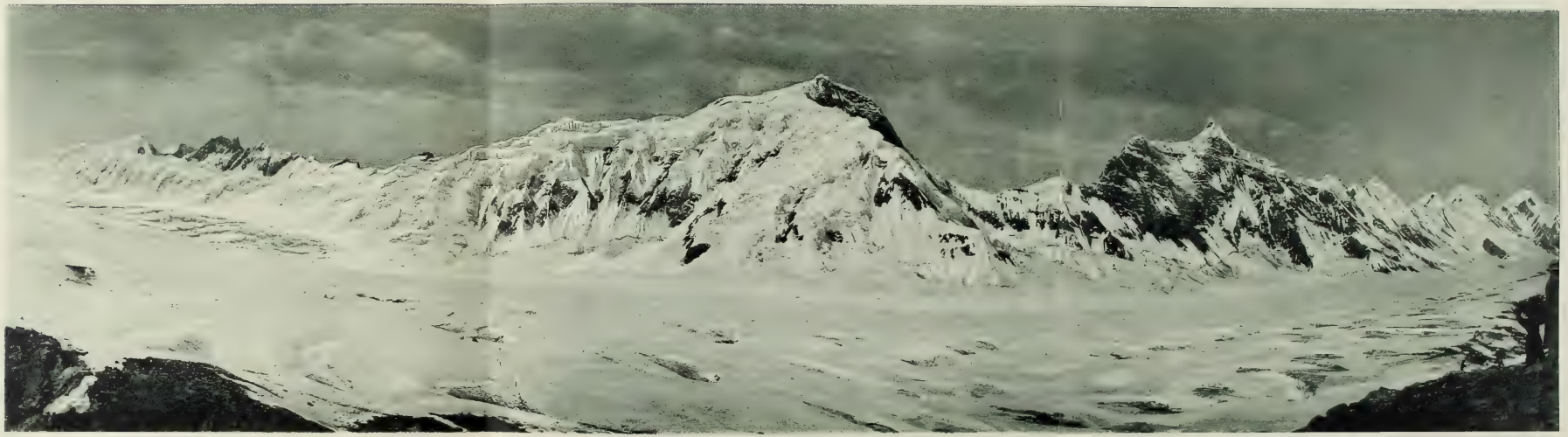
as 15,240 feet. Our calculations from two boiling-point readings on different days at our tents, at practically the same height as his camp, compared with the simultaneous Gilgit readings, give an altitude of 15,354 feet.

The view from this camp embraces the full sweep of the Hispar glacier downward to below the Makorum branch, and upward to the Hispar Pass, and of the long line of shaggy snow-peaks connected by wild cols forming the great southern wall of the Hispar. These peaks and the wall showed scarcely 200 feet of smooth slope anywhere. It was as if Nature had taken a huge axe and harrowed them out into split-up ice falls, hanging glaciers, and snow-arêtes of terrific angle, gashed by vertical and horizontal crevasses, a chaotic, arctic hodge-podge, awesome to the eye even of an experienced Himalayan mountaineer. Their defiant warnings, voiced by the hoarse roar of the avalanches hurled from their flanks throughout the twenty-four hours, were not needed to deter us from any attempt to invade their untrodden sanctity, for it was only too evident that not one of these peaks was climbable. Except at the point where we ascended Triple Cornice Peak

not a place on that wall for more than forty miles from the Nushik Col to the Hispar Pass and on down the Biafo could be scaled under any existing conditions.

The weather for the first three weeks we were on the Hispar was marvellously fine. Scarcely a cloud rippled the sky. During the cloudless days at this camp our tents were bathed in sunshine from early morning till after seven P.M. Although the temperature at night fell to 20° Fahr., there was no wind, and we did not suffer. There was just sufficient cold combined with the pleasantly warm days to make a delightful, stimulating summer-climate.

It was now necessary to send coolies down the glacier for wood, which consisted only of dwarf-willow bushes. To find these of sufficient size to be of any value the coolies had to descend the glacier a full march, so that two days were required for going and returning, and they took a third to collect the wood, which really was an unnecessary waste of time. While here thirty coolies were despatched for wood every three days, the rest being occupied in exploration and in fetching supplies. The coolies



Great south ice-wall of Hispar from opening of Makorum glacier on right to beyond Hispar Pass on left, about twenty-eight miles. Photo from Lower Base Camp. Note intimate connection of wall with glacier throughout its whole extent. *Vide* text, pp. 216, 221, 222.

were supposed to bring wood-loads of sixty pounds, but those they actually brought were ridiculously small. On being weighed, they were found to range only from sixteen to thirty-five pounds. Any one of them could have been collected in half an hour at the outside, and the third day the coolies claimed as necessary was spent merely in loafing and consuming the rations supplied to them. To obviate the imposition thus practised, the levy was sent down in charge of the coolies with strict orders not to allow them to waste time and to make them bring full loads, but he exerted no authority and the loads were as small as before. We may say here, that, although several levies were supplied by the Mir during the expedition, not one ever showed himself of the least value, and one and all proved to be useless encumbrances. A levy to be of any real service should be of a different race from the coolies he has in charge, which was here not the case.

The coolie-standard for the use of wood in camp was quite different from that applied in providing it. Had the coolies been allowed a free hand, they would have burned the whole quantity brought

by thirty of them in a single night. We granted them three loads per day, which was entirely sufficient for their necessities. When they took these from the common pile, it was amusing to notice that their conception of the amount of wood in a load had increased in six to ten-fold proportion. Each took away, instead of sixteen to thirty pounds, a load the bulk of which hid his form entirely from view, and, had the servants not interfered, it would have been larger still. The policy of the Nagar people in this, as in all else, was to render as meagre service as possible, and to secure all they could for themselves. The idea of rendering a fair *quid pro quo* did not appear to enter into their calculations. They did not think far enough to see that, should a long storm overtake the expedition, they themselves would suffer the consequences of shirking their duty by having no wood either for cooking or warmth.

Two days after Lower Base Camp was established, we had another reminder of the necessity of care in the selection of locations for camps, as well as in guarding against accidents while on the march. A glacial barrier in the mountains above

gave way, and a large torrent of mud-laden water came pouring down a declivity a short distance from the camp, inundated a névé-slope beneath, and entered the lake. We were safe from it as well as from falling stones, as the site had been chosen with due regard to the occurrence of such accidents. Had we camped on an inviting grass slope two hundred feet farther east on the declivity, we should have been directly in the path of the torrent. The discharge continued for twenty hours, so that the lake above must have been of good size to have required so long a time to drain it. This was the third *swas* or flood we had seen on the Hispar, two others occurring when we were on the other side of the glacier near the lowest, south branch. In 1899 we narrowly escaped being overwhelmed by one at the entrance of the Askor Gorge in Baltistan.[1]

On 18th July, though the sky was not so clear as it had been for the last three weeks, we started to explore the Kanibasar branch. This glacier, while not quite so long as the Jutmaru, is nearly, if not fully, as large, and is surrounded by mountains

[1] Vide *In the Ice World of Himalaya*, p. 156.

of similar imposing size and magnificence. The fates decreed we should make two nearly complete ascents and descents of it before its full treasures were unveiled.

Leaving camp at six o'clock, with one bearer, the lambardar, and eighteen coolies, we first traversed the steep and broken rock-face of a mountain to get around the lake, and then ascended an equally steep névé-slope in order to reach the glacier. After some rough but not dangerous scrambling, we came to free ice, which, although considerably furrowed, afforded a good path. Toward noon the surface became coated with snow, through which softened by the sun's heat we began to break into water lying and flowing beneath. There were also crevasses under the snow. We had now to advance with caution. As usual, under conditions involving danger, the Europeans of the party went ahead to search out a proper path, leaving the coolies behind to follow in the tracks made.

As we reached a trying place, sounds of discord were heard from the caravan some distance behind. We halted and turned to see what the matter was. We were too far away to perceive details, but from

the angry voices, uplifted sticks, and general commotion, it was evident that some revolt was taking place. After a few moments the tumult subsided, when we started on again, to show that, whatever might be the cause of the disturbance, we did not intend to turn back. Later it appeared that the bearer, a man of weak voice and none too much courage, had tried to urge the coolies forward, when they rebelled and attacked him with their sticks, giving him a good beating. The lambardar went to his assistance, using his stick freely in turn, and for a few minutes there was a decided scrimmage, which, considering the insecurity of the terrain, might have resulted in one or more being pushed into a crevasse. This was our first experience in having a servant attacked by coolies.

We were next brought up short by the sound of running water just ahead. The stream was not visible, but could be heard rushing by beneath a layer of half-frozen slush sufficiently stiff to resemble ice. Savoye cautiously tested the covering and the depth of the water beneath with his axe, and then started to walk across. When near the centre he broke through and sank to the waist in snow and

water. Being now wet to the skin, it only remained to plunge ahead, which he did, and soon got to hard snow again.

He called back to the rest of us not to wait for the coolies to carry us over, as we should have done had it been an ordinary stream, crossing which on coolie-back saves one the time and labour involved in taking off boots and stockings, and drawing them on again after wading over; for, he said, the bottom was uneven and slippery, and we should risk falling from the coolies' backs, if they fell. 'Crawl over on your hands and knees, using your axes for support. In that way the ice will hold you.' The weather had become threatening, and a crossing must be made to find firm névé to camp on. So one by one we threw ourselves flat so as to distribute our weight over as large a surface as possible, using the axe in one hand for the same purpose, and thus, though no one fancied the idea of breaking through into the ice-cold, rushing water in that position, we managed to crawl and wriggle ourselves over the semi-frozen stuff and to effect a safe and creditable crossing. Just before reaching the farther bank, our feet did break through a thin place, but Savoye's

At camp, 16,486 feet, near head of Kanibasar glacier on its first ascent. Mrs. Bullock Workman and modified Mummery tent used by her at high snow-camps on last three expeditions. Similar tents used by other members of expeditions at high camps.

strong hand hauled us up quickly on firm snow, damp enough all over, but much better off than if we had waded across the freezing stream. As in other instances where questionable places have been crossed, each one after his crossing had the amusement of watching the curious antics of those coming after him. Such occasions have often occurred as bright spots in the day's drudgery, and many ludicrous mishaps having no serious consequences have served to enliven the monotony of marching.

Beyond this place, the gradient became steeper and the glacier more heavily covered with névé, which was so soft that all sank well into it at every step. We pushed on, without looking back to see how the coolies crossed the river, to find a suitable camping-place, as it was evident the top of the glacier could not be reached on that day. At one o'clock P.M. a place was found, covered with nieve penitente, above water and safe from avalanches, where we camped at 16,486 feet.

The afternoon and night were disagreeable. The clouds thickened, and a sleet-storm broke over the glacier. We had no means of drying our wet clothing except the primus stoves, which were not

of much use for this purpose, though they sufficed for melting snow, boiling water, and heating food. We were, of course, quite accustomed to camping on snow for days and nights at a time at much greater altitudes, but we always grudged the expenditure of time involved in manipulating primus stoves when below 18,000 feet.

The next morning the weather showed no improvement, and it was so warm owing to the overcast condition of the sky, that the snow had not frozen. Farther progress, therefore, in the snow-clad reservoir of the glacier, which we had already entered, was out of the question. As the chances were that the bad weather coming on after three weeks of continued sunshine would continue for some days, nothing remained to be done but to return to Lower Base Camp. On the downward march a median moraine near the west side of the glacier was followed, by which course the water-soaked area in the centre encountered on the ascent was avoided.

On reaching Base Camp we found that fifty new coolies had arrived to replace those who had been with us. As sixty were needed with us, ten of the old set agreed to remain, and the other fifty were

furnished with rations and sent down to our agent at Hispar to be paid off. It had been arranged that he should pay all coolies at the expiration of their terms of service on presentation of written orders from us stating that they were to be paid and discharged. In order to identify them and prevent fraud, lists of the coolies sent to us were made, giving their names, their fathers' names, the names of the villages from which they came, and the dates of their leaving Hispar. All these items were necessary, as the variety of names was not great, and several coolies having the same name were on every list, but it was very unlikely to happen that two coolies of the same name would have fathers of the same name, come from the same village, and leave Hispar on the same day.

When the fifty coolies arrived at Hispar bearing our letter with list of names, the number presenting themselves to the agent for payment had increased to sixty, having been augmented at Hispar or at some other point by the addition of ten others. On calling the roll to determine who the impostors were, he was baffled by the circumstance that many of the coolies now gave different names and different

fathers' names from those originally given, and he was put to considerable trouble to separate the goats from the sheep. Whether the variation of statement on this occasion was intentional or due to a general looseness in the use of names could not be determined, but very likely the latter was the case, as the same thing was noticed in other instances where there was no apparent motive for deception.

During the next nine days the weather was variable. Rain, snow, sunshine, and clouds, succeeded one another. During the intervals of sunshine we made excursions on the Hispar, and ascended the rock-mountain, at the base of which the camp was situated, to an altitude of 17,000 feet for observation purposes.

One reconnaissance was made on the Hispar to seek a place for a still higher base-camp. Two hours' march above Lower Base Camp, at the entrance of the last glacier from which rock-débris can be seen to be given off to the Hispar, a large, ancient, lateral moraine similar to the one we were now tenting on was found. The top of this moraine was just emerging from the snow, and, although it

Site of camp, at 16,601 feet, near head of Kanibasar glacier, on second ascent of glacier. Camp has been struck and coolies are preparing to march.

presented the usual cheerless, sodden, bedraggled condition characteristic of surfaces recently freed from snow, in a few days it would be sufficiently dry to serve our purpose. This was the last bare spot on the glacier-bank and was just below the ice-falls breaking down from around the head of the Hispar.

The morning of the 29th July broke cloudless. We left camp at six-thirty with twenty coolies to reascend the Kanibasar. The night had been clear, and the thermometer had registered 20° Fahr., so that the surface of the glacier was hard frozen and in excellent condition. We pushed rapidly forward, following the route by which we had descended ten days before, passed our former camping-place, and at three o'clock reached a spot at the base of a sharp snow-slope near the head of the glacier, in a wild basin surrounded by magnificent, serrated peaks festooned by fantastic snow-cornices. Here we camped at an altitude of 16,601 feet.

The névé at the head of the Kanibasar was extensively covered with parallel ridges, the crests of many of which were sculptured out into nieve penitente-pyramids. These ridges on inclined slopes fol-

lowed the direction of the inclines, turning with the latter. Some of these were probably formed by the downward subsidence of the névé, but, on the more level surfaces, they were undoubtedly raised primarily by wind action, and increased in height by subsequent melting. In places, beds of more recent, white névé thus striated and surmounted with penitente-pyramids alternated with older, dust-stained ones, and the ridges of the newer corresponded with and formed continuations of those of the older névé. On removing the penitente-pyramids of the former with the axe, they as well as the ridges were found to be built up on the older system lying beneath them. Nieve penitente of the avalanche-variety was also found on avalanche-beds, and, lower down on the glacier below the névé-line, groups of glacier-table penitente were seen.

Early in the morning while the névé was hard frozen we went up an hour farther to the head of the glacier to see if any passage to the north existed, but none was found, for the reservoir of the glacier was everywhere enclosed by inaccessible walls and summits, as was also the case with every other part

Massif heading in east end of east branch of Kanibasar glacier.

of the glacier. After returning to camp tents were struck and we descended the glacier to the opening of a large eastern tributary, which enters it several miles above its junction with the Hispar. Here the coolies were left, while we pushed up some two hours to the upper part of the tributary, at the head of which towered an imposing massif rising in two sharp summits. Here again no passage could be discovered. The upper half of this glacier was covered with snow, which was so softened by the sun as to greatly retard our progress, and beneath the snow were numerous crevasses, that rendered roping and great caution necessary. As nothing was to be gained by remaining at the head of this glacier, we descended after a short halt and rejoined the caravan, after which all returned to Lower Base Camp, reaching it late in the afternoon.

In 1903, when Mrs. Bullock Workman with Petigax and Savoye reached the Alchori Col, on the south wall of and overhanging the Hispar, they saw a large, north branch of the Hispar opposite them which Mrs. Bullock Workman photographed. This photograph shows a large snow-mountain east of the head of the glacier towering above all others

around it. The existing maps of the Hispar region were so deficient in detail that the glacier could not at that time be identified, but there seemed little doubt that the peak was the one marked on the Survey sheet we were then using as Peak No. 4, 25,503 feet. The photograph was reproduced on p. 376 of *Ice-Bound Heights of the Mustagh*, and the peak marked as given on map. Later information obtained from the Survey in connection with the present Expedition gave the Kunjut Peak No. 1, 25,460 feet, as the highest fixed peak in this vicinity, it being presumably the same peak as the above. By an unfortunate circumstance, the photograph was not with us on this expedition, and memory of a landscape seen only for a short time on an occasion when it possessed no special importance could not be relied on for the identification of special features of a complicated landscape seen from different points and under different conditions several years afterward.

As we ascended the Hispar after leaving the Jutmaru we readily recognised the Alchori Col, and, as a corollary, identified the large glacier opposite it as the Kanibasar, heretofore, as already stated,

Kanibasar glacier from near west end of its junction with Hispar. Large snow-peak at left is Kunjut No. 1.

unmarked on the Survey or on Sir Martin Conway's map, the Jutmaru having the name of Kanibasar on both.

On the sheet No. 2 S.E. of the Northern Trans-Frontier map of the Indian Survey, which we had with us, as well as on Conway's map, a peak marked 25,460, the altitude assigned by the Survey to Kunjut No. 1, is placed west of the upper end of a glacier corresponding to the Kanibasar, but it may be stated that from no point on the Kanibasar could we discover any peaks of especial altitude in that locality. Indeed, the mountains on the west side of the glacier, and particularly west of its upper end, appeared much lower than those on the east side.

While crossing the opening of the Kanibasar into the Hispar we noticed a snow-clad peak rising to the east of the upper end of the glacier, but, owing to the curves of the stream, its relation to the glacier could not be determined. On account of its distance and from the fact that it was partly hidden behind a *contrefort* of a large and high massif nearer to us, in comparison with which its dimensions were greatly dwarfed, it did not impress

any of the party as an unusually high peak, and it was dismissed from our minds.

We did not see it again until, in ascending the glacier, we passed out from the shadow of other imposing mountains directly into its neighbourhood, skirting its base. Here again, owing to foreshortening, or some other inexplicable optical illusion, although recognised as a fine mountain it did not appear as one of supreme height. The same was the case on the second ascent of the Kanibasar. The mountain was commented on and photographed, but it did not produce the impression on our minds of greatly overtopping its neighbours.

After the two ascents of the Kanibasar, having seen no peak that appeared so much higher than those around it as to correspond with that photographed from the Alchori Col, or as high as it seemed that Kunjut No. 1 ought to appear, we concluded, either that we had been mistaken in our identification of the peak photographed by Mrs. Bullock Workman, or that we had not seen it at all from the Kanibasar, and hence reported to Drs. Calciati and Koncza that we had not been able to identify either Kunjut No. 1 or Kunjut No. 2. As they state,

they were not able to identify either of these Kunjut peaks, and it is certain that they could not have seen Kunjut No. 2 from any point they visited, or from any position short of a high one on the impossible south Hispar wall.

A comparison of the photograph from the Alchori Col in 1903 with those taken by us on Triple Cornice Peak and the Kanibasar glacier, now completely establishes the identity of the high peak seen to the east from Triple Cornice Peak with the one east of the head of the Kanibasar glacier, seen from the Kanibasar and from the Alchori Col. Further, both personal observation and the photographs from Triple Cornice Peak and the Alchori Col show that it is a good deal higher than any mountains around it. As it is situated very near the place designated by the Survey for Kunjut No. 1, 25,460 feet, there appears to be no doubt of its identity with this peak.

Having finished with the Kanibasar, we were free to turn our attention to establishing a higher base-camp. The day after our return forty coolie-loads of wood were sent to the moraine-ridge that had been selected, and the following day the whole

camp was moved up. On arrival the crest of the moraine, which alone was free from snow, was found to be still damp, while from the few grass-tufts scattered over it young, green shoots were just sprouting. Summer was trying to assert itself on this lone ridge, that had raised its head above the snow enveloping it. In another month winter would let fall again its icy mantle, crush out the bright green grass, and hold its sway for another eleven months. Great, sloping névé-beds, ribbed with parallel ridges running in the same direction as the slopes and crowned to a considerable extent by nieve penitente-pinnacles, covered the hillside above and descended to within a few feet of the walls of our tents pitched on the narrow patch of bare ground.

This camp, established at the very highest point available for a base camp, was named Upper Base Camp. Its altitude was 15,900 feet. The view from it was similar to that from Lower Base Camp, ranging from below the Makorum glacier to the Hispar Pass, that, however, of the head of the glacier and of the ice-falls leading up to it being correspondingly finer. Directly over the moun-

Upper Base Camp, 15,900 feet, at junction of Last Moraine glacier with Hispar, on last spot not entirely covered with snow.

tains enclosing the Makorum could be seen the upper part of Pyramid Peak, at the head of the Chogo Lungma glacier, ascended in 1903 by Dr. Workman, Petigax, and Savoye, to a height of 23,394 feet. Not a vestige of anything green was visible, only a succession of rock, ice, and snow, on all sides. The scene was especially impressive on the six glorious, moonlight nights we passed there, when the long stretch of glacier and one side of the great chain of icy sentinels running for twenty miles opposite the camp were bathed in silvery light, while the outlines on the other side were softened and almost obscured in mystic shadow. The effect of the contrast was heightened by the absolute silence that pervaded the region, a silence only accentuated by the occasional thunder of an avalanche.

The servants found a dry spot a short distance below the one we occupied, where they pitched their tents, and the khansamah put up a small, spare one near his own for the fowls, which all turned into it quite naturally at night as glad as human beings to get shelter from the cold.

CHAPTER VII

Biafo Hispar Watershed Peak—Upward to its icy Fastnesses—Coolies refuse to proceed—They attack Savoye—Camp at 19,100 feet—Savoye makes Reconnaissance—Weather becomes threatening—Party divides to make two Ascents before Storm breaks—Ascent of main Peak—View from Summit—Ascent of second, lower, Summit—Descent to Hispar Glacier—Camp on Glacier in Storm.

FROM Lower Base Camp we had crossed the Hispar to get a better view of the pointed rock and snow-needle at the head of the glacier mentioned as seen from the Haigatum. This stands about four miles north by west of the highest point of the Hispar Pass, surrounded by ice-falls, snow-arêtes, and lower peaks, at the entrance of a great, snow-clad upland rising some 2500 feet higher than the pass, and running back three to five miles from the northern line of the Hispar. The snow from this upland mostly finds its way into the Hispar, though a certain proportion at its eastern end goes to feed the Biafo. The peak is a quadrilateral pyramid, its sides bounded by four arêtes leading up to or descending from its apex. Two of these descending,

South aspect of Biafo Hispar Watershed Peak, its four arêtes, and its contreforts extending east and west. Photographed from Hispar Pass at point directly south of peak. Eastern contrefort ends in triangular rock-face at right, beneath which west-north-west head of Biafo descends from Hispar Pass. Névé glacier passes down to Hispar between the western contrefort and mountains rising behind and above it.

approximately, one north-east and the other north-west, are, for a distance of half a mile or more, thin, with ragged, knife-like edges fringed with cornices. Both of them then turn in elbows at right angles with their former courses, and widen out, throwing out several transverse arêtes. From its elbow the north-east arête runs south-east to the Biafo region, and the north-west one south-west, forming the lower part of the east wall of Névé glacier. These arêtes in their entirety resemble the projected front limbs or flippers of a sea-tortoise.

The other two arêtes descend in straight lines, respectively south-east and south-west, to the broken ice-region surrounding the south face of the peak. These are not quite so knife-like as the other two, though the south-east one is as much so as is safe for the climber, but they rise at much steeper angles. The south-west arête from many points appears broken off and resolved into the wall at about a third of the distance below the apex, conveying the impression that the peak is a triangular instead of a quadrilateral pyramid.

As we saw the peak looming up beyond a labyrinth of ice-falls above its great western *contrefort*, it

exercised the same fascination upon us as it had on other occasions, and its situation at the very summit of the Hispar dominating the whole region, with no peaks of equal or greater height near it, made it so manifestly a view-point of the first order that, after studying it carefully through our glasses, we determined to try to conquer it. Moreover, although evidently a difficult and dangerous peak, it was the only one of importance we saw from the glacier which gave any promise of being scalable.

One day sufficed to get everything in order at Upper Base Camp. As the following morning, 1st August, broke fine, we wasted no time, but started at six o'clock, in a temperature of 13° Fahr., with the lambardar, nineteen coolies, and two servants, to have a try at the mountain. Provisions for three days were carried, as it was apparent that two snow-camps at least would be necessary. Our chief bearer expressed his desire to go with us, so he was taken as one of the servants, although we thought he would be of little use at high camps. He was the first servant we have employed who presented a *chic* appearance in camp when on the march, and he was never known to fail, in all places

South and west faces of Biafo Hispar Watershed Peak from northern side of Hispar Pass nearly south-west of peak.

below the snow-line, to wear decent clothing and a spotless pugaree.

The route led up over steep, rolling slopes of the glacier, which from here rises with a much sharper gradient than below, then to the left, up among the ice-falls that tumble down from the great upper snow-fields north of the Hispar Pass. For the first hour until sunrise a bitterly cold wind rendered our warmest coats necessary, but later the sun became so hot on the dazzling snow-fields that these had to be discarded. The coolies being newly arrived, and not having been informed whither they were going, were docile for the first few hours, and marched fairly well up the long, frozen slopes.

As the peak came more clearly into view, all saw that the north-west arête, descending in the long, sharp wall already mentioned, was not the one to ascend. So we pushed on under the face of the mountain so as to get around to its eastern side beyond its southern arêtes. In doing this, we had to round the long, white western ridge and then climb among the ice-falls and up, seemingly, endless snow-fields. At last a high snow-basin between the north-east and south-east arêtes came in sight,

which was evidently the spot where we should have to camp, in order to attempt the peak with any chance of success. The basin was still distant, but appeared accessible. The question immediately presented itself, Could the coolies be induced to go up to it ? From our experience with them we feared they would not go. If they would not, then our attempt on the mountain was doomed to failure, for it was clear that we must camp overnight in that basin, and make the attack from there early in the morning. The expediency, indeed the necessity, of reaching the basin the same afternoon was also equally clear, on account of weather-considerations, and of the danger to our plans of permitting the untrained coolies to camp on the snow short of it. The deprivations and discomfort of snow-camps do not appeal to coolie-instinct, and we have found, where they have passed one night on snow, it is very difficult to persuade them to go higher. Though haunted from this point on by the spectre of coolie-insubordination, which ever shadows undertakings of this nature, we went forward, determined to leave nothing undone to establish our camp in the basin that afternoon.

By eleven o'clock we were well above the Hispar

South and east faces of Biafo Hispar Watershed Peak rising from the broken ice-region around it. Route through ice-falls to camp on its flank. Also of Mrs. Bullock Workman's party from camp to summit, and of Dr. Hunter Workman's to summit at north-east.

Pass, which lay below, somewhat east of south, about three and a half miles distant. The coolies were an hour behind toiling slowly upward. At half-past eleven we reached a small snow-plateau at the base of a steep slant rising about 800 feet. Here was the place, if anywhere, where the coolies, with that slant before them, would make trouble. If they could be brought above the slant, a climb for them of two hours, there would be little difficulty in reaching the basin. We paused to consider whether we should have our luncheon here and wait for them, or push on up the slope. If we waited for them to come up, it seemed almost certain that they would refuse to go farther and compel us to camp, which would be tantamount to abandoning the attempt on the peak. We all felt the only course to pursue was to defer the luncheon and to ascend the slope without delay, which would be equivalent to informing the coolies, without saying it in words, that we entertained no doubts as to their willingness to follow us, and expected them to do so. We therefore at once began a zigzag up the slope, which in places had a gradient of upwards of 60°.

The snow had now become softened by the heat

of the sun, and Savoye and the porters were kept busy in treading out steps to facilitate the advance of the caravan when it arrived. We were more than ever convinced that this wall would offer the critical test of the Nagar men, and were fully prepared to descend again should they refuse to come up. We kept on without stopping, and reached a point about 500 feet up the wall, when the coolies arrived at the base, where they all sat down. In a few minutes, not at all to our surprise, the bearer called up rather weakly that they were tired and would go no farther.

We answered, ' Tell them they must.' On hearing this they began to remonstrate in angry tones. The lambardar then harangued them, and ended with a vigorous use of his stick upon the most vociferous. After this they started and went on for a short distance, when they again stopped in a determined manner. A porter now descended to them to see what he could do, but neither he nor the lambardar nor the servants, after much argument, could persuade the recalcitrants to move. Savoye, becoming impatient, threw off his rücksack, saying, ' Je descends.'

Caravan ascending to camp on flank of Biafo Hispar Watershed Peak. In background south Hispar wall, descending south of east above west-north-west head of Biafo glacier. Four peaks of Biafo west wall behind it. Gradients of foreground distorted and greatly flattened, photograph having been taken from much higher point above caravan.

We told him to explain to the lambardar that, if the coolies went higher now, they would return to Base Camp twenty-four hours earlier than if they stayed where they were overnight, and they would have one camp less on snow. He talked for some time with the lambardar, who, seemingly, did his best to explain matters to the coolies, but made no impression on them, for they only became more excited. Suddenly, to our surprise, three of the most demonstrative Nagaris attacked Savoye with their spiked sticks. He in self-defence struck the strongest of them over the back with his ice-axe and felled him to the snow. That settled the affair. This argument they understood. They ceased their demonstrations, fell into line, and shortly began to file slowly upward.

An officer on the Gilgit route, when asked as to the calibre of the Nagar coolies, replied, ' Oh, they will go almost anywhere, but they will not stand the stick.' Apparently on this occasion the ' almost ' point had been reached. As to the stick, there is no doubt that they well deserved it, and they got it often from the lambardars. But that was the Mir's affair, not ours. This was the first time a

coolie ever attempted to strike any European with us. It was also the first and only time that a coolie was struck by our Italian companions, and here necessity demanded it. The thoroughness of the application by the powerful arm of Savoye had an immediate and highly salutary effect, winning respect for the authority shown.

We now continued on with two porters and two servants, not waiting for Savoye, who remained with the coolies to lead them. They complained and stopped constantly, yet advanced little by little. When the steep slant was surmounted, we reached an easier gradient leading to a sloping névé-surface under the huge, avalanche-scored ice-wall of the peak, between the two arêtes, one of which would have to be ascended, that sweep down right and left in continuous sharp shoulders of 2000 feet or more. The apex of the peak from which they diverge was seen to be a very small snow-cap, probably corniced on the farther side, not here visible.

Half an hour after our arrival Savoye came up, carrying part of a load, followed by a few coolies. He said some would not come for another half-hour, and some might not come at all. The porters

Highest camp, 19,100 feet, on flank of Biafo Hispar Watershed Peak, from which ascents of that and a peak to north-east were made. Mountains behind rise from upper end of west Biafo wall.

and tent-servants started down to help them, and brought up some of their packs. After several journeys everything was got up and the camp was pitched. We would here say, our Italian porters as well as Savoye always rose to the occasion in situations like this.

After bringing several of the coolies' loads and helping to pitch the tents, they melted snow and made their tea after the long and thirsty day's work. Then Savoye with one porter went off to examine the north-east arête, which appeared from below to be the more promising one to ascend. We also busied ourselves with snow-melting and tea-making, after which readings of boiling point, aneroids, and thermometers were taken, among other preparations for present comfort and the morrow's work. Calculations from the readings give the altitude of this camp as 19,100 feet. We were well satisfied that we had persisted in reaching this point on this day, as the filmy appearance of the sky near the horizon was not promising, and the temperature was too warm for the altitude. These two signs indicated the approach of unfavourable weather.

Returning from his reconnaissance, Savoye reported that the north-east arête, on the Biafo watershed side, was not practicable, being very narrow, and fluted with snow-cornices, which might easily give way if trodden upon. He said the south-east, much steeper arête, facing the Hispar Pass, though also narrow, offered the only means of access to the summit. It was therefore decided to attack that.

The servants, who had assisted in preparing the camp, now lay mountain-sick in their tent, so without their aid we completed our preparations for the morning's work, cooked our dinner, and made everything snug for the night. We turned into our sleeping-sacks with serious misgivings as to the weather. The wind moaned dismally and shook the tents in fitful gusts the whole night. This, with the altitude, prevented us from obtaining much sleep. Savoye called us at dawn. On being asked as to the weather, he replied it was none too good. Some of the mountain-summits were covered, but the sky was nearly clear. He thought it might hold sufficiently long for the ascent to be made. On stepping out of our tents and examining the sky, it was evident the weather could not be counted

Furrowed, unclimbable, ice-covered face of south-east arête of Biafo Hispar Watershed Peak. Beneath, our camp at 19,100 feet, from which peak was ascended upon skyline of arête. Below, at left, Hispar glacier. Above it, its southern wall.

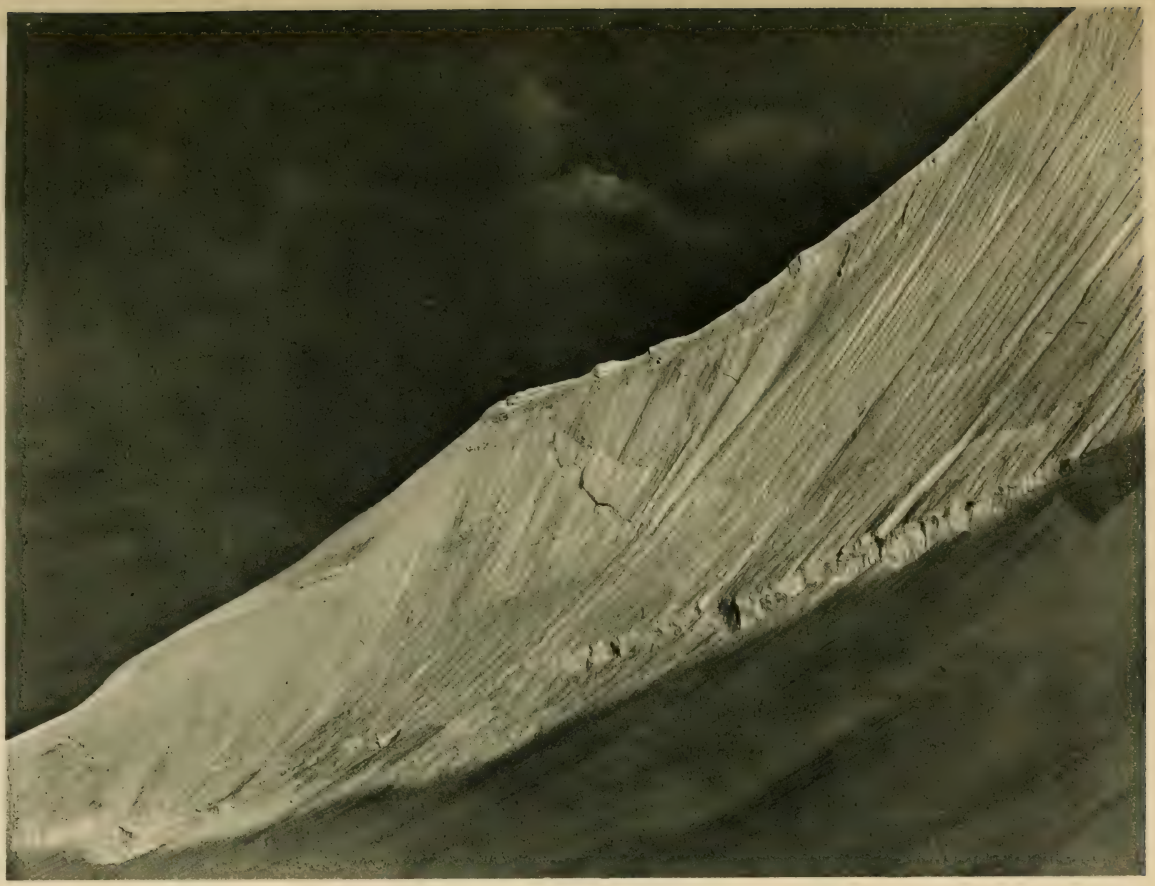
on for more than a few hours, and that we ought to get down to the glacier that afternoon to avoid being stormbound.

It was desirable to ascend the peak, and also a lower summit on its great north-east arête, overhanging the Biafo side, for topographical purposes. As conditions now were, if we kept together we might do either one, but not both. Whichever we omitted to do would probably never be done, as it was certain that the coolies could not be induced to come up to this point again. It was therefore decided to divide the party: Dr. Workman with one porter visiting the lower summit, while Mrs. Bullock Workman, with Savoye and two porters, attacked the main peak. The minimum temperature was 13° Fahr. The party for the peak started at six-fifteen o'clock, which was as early as it was safe to attempt the exposed arête that had first to be traversed. The following account of the ascent is quoted from an article by Mrs. Bullock Workman:

'In twenty minutes the intervening slopes were covered, and we stood at the base of a difficult snow-wall leading directly to the south arête. The guide and porters had hurried over there late the

afternoon before and cut steps to the arête and somewhat above, which made our present progress more rapid. It was, notwithstanding, a very exhausting piece of climbing to start off with. To those not having been on the mountain, it would appear that, having climbed the wall, we had only to step on the arête or shoulder and walk to the summit. This was not quite the case. There was a dizzy, snake-like turning to make, which brought the snow-sheet just ascended into full focus, and such declivities are more agreeable behind than in front of one. Then Nature had that season placed a few strong, but unpleasantly sharp snow-pinnacles in our way, and these had to be climbed over, there being no room to round them.

'Savoye now took two long steps to the arête and stood like a beacon directly above my head. He drew the rope, a light silk one used on all our hardest climbs, taut, and remarked, "Don't be surprised, Madame, at the precipices, and turn the arête rather quickly." I had my mind made up against surprises, for I knew the ascent of this mountain meant meeting a series of precipices in all directions. Making two long leaps I stood in his



Section of south-east arête of Biafo Hispar Watershed Peak. Party ascending on its sharp edge seen on skyline to left of elevation in centre. Photo from camp below.

place on the arête, while he moved on a step or two. And what an arête ! a foot and a half wide at most, and completely ice-glazed at this hour.

'While as moral support the snow-wall fell to the right, to the left sank a much deeper, seemingly endless precipice filled with the gloom and warning such abysses possess, before sunlight has turned their yawning depths into mountain tangibility. Giving only a glance at this demoniac chasm we moved on slowly but sharply heavenward. Step-cutting soon began in deadly earnest.

'"C'est beau, n'est-ce pas ?" said the guide after twenty minutes, stopping to take breath, with one foot in an ice-step, the other dangling in the air.

'"Peut-être pour un chamois," I replied. Ever upward we went, *sempre avanti*, the shoulder never widening but growing sharper, and the side-precipices deepening until they appeared lost in a bottomless pit or the root of the mountain. After an hour we reached a series of gendarme-decorations, for the mountain meant to give us a little rock-climbing. Huddled up against one of these, we had a drink of tea and some plasmon chocolate, and Savoye, ever happy over such work, sent forth a

jodel, which resounded over the distant snow-fields beyond camp and arrested the progress of the others, now well on toward their goal.

'Our five-minute rest ended, we silently set to work to conquer these pointed, jagged intruders, which were very disintegrated and rotten. One of the porters broke off a great piece in stepping and lost his footing, while the rock crashed down into the abyss with reverberant roar.

'Beyond the rock-zone came a short, easier slope topped by a blue ice-wall, above which the arête continued, a long, glistening, white shoulder, steeper, much steeper even than it had been. The summit was not yet in sight, but it was doubtless up there somewhere at the end of the steepness. I stopped now a few minutes to photograph and note my instruments, but not long, for toward the Hispar glacier the weather looked threatening, while towards Baltistan the sky was still cloudless, the sun gloriously illumining the great Snow Lake at the head of the Biafo glacier, which latter swept south-east, a long purple snow-river still in shadow. Far away hung, as I have often seen it, apparently between earth and sky, the grey massif of K2.

'Gathering all our energies, we attacked the blue ice-wall, our one thought being to reach the top before fog should cut off the view. This was a nasty fifteen feet. As the sun was at work melting the ice, the steps were hard to cut clean, and, when cut, at once filled with water. We moved sideways, each foot only half in a step. Beneath, exposed to full view, lay more than half the mountain, a tortuous, precipitous mass, inviting to instant death should head or feet fail.

We hailed the great snow-arête again, although it was tug-of-war work now with the awful sharpness and softened snow, which made climbing most arduous. I have often felt on snow-slopes what I call the tremor of the snow. It is the contraction of the outer surface under pressure of those climbing, I suppose. It is not necessarily dangerous, and may occur on any slope. It gives one the feeling that an avalanche may occur, and it always gets on my nerves. Here, when I felt the snow give and crack on this last, tremendous slant leading straight skyward, I felt chilled to the very bone.

'But this ascent had to end, as all do, and finally the *grande arête* came to a climax, and suddenly

the top was seen ten minutes beyond. We climbed an easier slope, then another narrow, gruesome shoulder to a group of spiked rocks, and thence straight up the small, rounded cone, which, as we had expected, turned over to the north in a *capuchon* or cornice. It was so firm that, one at a time, we were safe standing on its brow, with, of course, the others holding the rope just below. We waved streamers and called loudly to the second party, now seen on their summit across a great void, but received no answer. They kindly remarked later that they had stood in mute admiration when they saw us appear against a background of cloud on that creepy-looking corniced top. It seems the peak looked more aerial, more impossible of ascent from where they were than from any other point.

The view from this mountain was, perhaps, the most comprehensive and beautiful I have seen in Himalaya. This single pyramid stands alone, with no near, higher peak to mar the view on any side. To the east, five or six thousand feet beneath, lay Snow Lake, whose glacial branches spread like white fans, clearly defined, framed each by its border ranges. Beyond this swept still farther east a

Mrs. Bullock Workman and two companions on summit of Biafo Hispar Watershed Peak, 21,350 feet.
Telephotograph by Dr. Hunter Workman from summit to north-east.

great glacier, unbroken by crevasses, fully ten miles behind and beyond the towering B15 range to the base of a high snow-wall, which joins the perpendicular rock and snow-slopes on the east side of the peak B15, 23,914 feet, which ten years ago, on our ascent of the Biafo, we named Kailasa. This peak rose like a colossal, medieval castle in turrets of ice and stone. Miles beyond, seen perfectly clear on that morning, the Baltoro giants K2, the Mustagh Tower, Gusherbrum, and the Golden Throne caught the eye.

'To the south-east the Biafo swept downward many miles, till lost behind dark mountain-flanks. Straight across, beyond the Hispar southern ridge, I saw the void between it and another parallel ridge which indicated the presence, 2000 feet below, of Cornice glacier, first discovered by us, from the Col des Aiguilles at the head of the Hoh Lumba glacier, in 1903. The high wall and mass of peaks cutting it off from the Biafo on the east, and the almost perpendicular walls separating it from the Hoh Lumba and Sosbon glaciers on the south were clearly seen, as well as the cols we had climbed at the heads of these glaciers; also the western

boundary formed by the Alchori mountains, which we followed up in 1903 and found no opening in. I was thus able from this peak to obtain confirmatory evidence of our opinion, formed from observation in 1903, that Cornice glacier lies in a deep hollow, with no observable outlet at any point. We have examined its barriers on every side, and believe it to be an example of what Sir Martin Conway says cannot exist, an enclosed glacier.

'On the west, although clouds made the vista less clear, twenty miles of the Hispar glacier were visible and the inaccessible peaks walling it in. Above these I recognised Pyramid Peak at the head of the Chogo Lungma, and the sublime form of Domani overtopping all. North of west stretched range after range of wild mountains unmapped, uncharted, beyond the frontier, and in the foreground of these, what from its position appeared certainly to be the highest, Kunjut Peak No. 1. It was for a minute a glorious, snowy vision, but can be recalled only as a stage-phantom, for a great dark curtain of mist fell between me and it, the purdah of storm so fateful to mountaineers.

'Biafo Hispar Watershed Peak may truly be said

to include in its vista of sixty miles east and west a panorama of superlative grandeur of one of the most magnificent mountain-landscapes in the world. I had seen wonders not of earth, the memory of which will cling while life lasts. Knight calls his book aptly *Where Three Empires Meet.* My eyes beheld at a glance on that eventful day the whole glorious region encompassing the meeting-places of three of Asia's greatest mountain glaciers.

'I had hardly finished noting temperature and instruments, when a band of fluffy mist entwined itself around our cornice, and one-half the mountain-world was lost in a sea of cloud. The other party, still visible on their standpoint, related afterward the striking picture we presented—three black figures encircled by a wreath of cloud, not standing on a peak at all, but hung high in a heaven of oncoming mist and storm.

'We retreated to the group of rocks below the top and, shivering, ate our lunch while waiting for the mist to distribute itself that we might enter on the hazardous descent. We chatted over our meal, and I wrote notes, which were placed in a tin box in the rocks; but I know all were silently speculating

as to the outcome of the descent. That an element of danger lurked in the conquering of this peak is certain, but an ascent devoid of all risk is colourless. The noted climber Mummery, who challenged the mountains once too often on Nanga Parbat, said truly, " There is an educative and purifying power in danger that is to be found in no other school."

' As the mist was chased back by an icy wind, we started down, following carefully the old steps, which for some time were still intact. When the ice-wall was reached, while treading backwards I slithered a bit, for the steps had melted and both feet went free, but the rope-ring around my waist tightened like a knife; in another second I caught rightly the next step and, turning face forward, risked a leap which landed me safe on the arête. Savoye behind had, of course, surmised my intention, and being the expert guide he is, let out the proper length of rope immediately to enable me to do this last.

' By unending care and watchfulness of every movement, we passed safely through the shifting fog, down the shoulder, past the precipices, now filled with cloud-billows, and over the snow-wall,

Summit of Biafo Hispar Watershed Peak rising behind mountains near head of Biafo glacier. Telephotograph from Biafo at distance of about ten miles from peak.

at present rendered tiresome and unnerving by the melting snow conditions, and at last, plodding halfway to the knees in wet snow, arrived at camp, where the others, who had returned shortly before, greeted us with bravos of welcome. They did not say so, but I fancy they were relieved to see us safe back again. The porter ventured the remark to me, " C'était quelque chose à voir, cette ascension, Madame."

' This peak was named Biafo Hispar Watershed Peak. Its height, since computed, is placed at 21,350 feet. Savoye hoped it would work out near the height of our Pinnacle Peak ascent of over 23,000 feet in the Nun Kun, but it did not, and, as I told him, we did not come to the Hispar to make records.

' This and the other climb of Dr. Workman are the first and only ascents to date of high peaks overlooking Snow Lake, the Hispar Pass, and the Biafo glacier. I am quite satisfied with all except the storm that came on to prevent the taking of many photos we wished to get. Ten days later, owing to the changed ice-conditions, this ascent could not have been carried out, and I venture to add that,

should a second ascent be attempted, no tiro and no one subject to vertigo should be of the party.

'As to mountain sickness, we were far too accustomed to high altitudes, and too busy and excited in carrying out our endeavour to reach the summit, to give it a thought.'

Meanwhile, Dr. Workman and one porter had ascended the ice-wall of the great north-east arête to a snow-summit 19,500 feet high, overhanging the northern tributary of the Biafo, from which they had a fine view of the Biafo region except the highest mountain-tops, which were hidden by the clouds and mist of the approaching storm, of the head of the Punmah glacier over the lower intervening ridges, and of K2 and other Baltoro peaks. Photographs were taken of the other party when near and on the summit of Biafo Hispar Watershed Peak, but the tone of the murky sky forming the background to the peak was so similar to that of the snow of the peak itself, that sharp outlines in a majority of them were lost. The snow on the outer, or east, side of the great, curving arête his party were on falls directly to the north-east head

Peaks of Biafo west wall.

South Hispar ice-wall sloping downward to rock-promontory on left.
Summit Hispar Pass beneath smaller snow-peak.

Extremity of north-east-south-east contrefort of Biafo Hispar Watershed Peak.

Rock-promontory.

Caravan ascending.

Extremity of south-east arête, Biafo Hispar Watershed Peak.

Junction of Biafo and Hispar glaciers, from point near camp on Biafo Hispar Watershed Peak. Owing to height of observation-point above foreground, gradients appear flattened and reversed, and distances greatly foreshortened, making it difficult for reader to judge of exact relations between different features. Between extremity of contrefort on left and rock-promontory, the base of which it appears to join, an interval of a mile or more exists, through which west-north-west head of Biafo descends.

of the Biafo, while much of the snow on the west side of the arête and in the depression between it and the peak, finds its way in ice-falls into the western head just below the Hispar Pass.

Both parties returned to camp about noon. Savoye suggested remaining till the next morning to recover from the fatigue of the work accomplished; but, as the signs indicated that the approaching storm would break during the afternoon, and one could not tell what might happen if we were overtaken by it in this elevated, exposed position, we voted for immediate departure.

Accordingly a hasty meal of biscuit, tinned meat, and coffee, having been taken, tents were struck, our effects packed, and at one o'clock the caravan started downward. We went ahead with Savoye and the porters to make sure of the path for the coolies, and descended the steep slopes leading down to the glacier much faster than they, as they did not march with the celerity coolies usually exhibit on homeward marches. Having seen to it that the path chosen was safe, we did not delay for them but kept directly on, till at four o'clock we reached the glacier below the ice-falls. Here we waited

above an hour for the caravan, the weather meanwhile becoming thicker.

At last the coolies came creeping up in batches. Before they all arrived, the storm broke fast and furious upon us, with blinding snow driven by strong wind-gusts. We at once proceeded to shelter ourselves with such of the tents as were at hand, and gradually, as the remaining coolies arrived, got the camp into an inhabitable condition, though not much comfort was to be derived from our snow-bedraggled belongings. After a none too cheery night we left in the still-falling snow for Base Camp. On arrival, the bearer, who had elected to go to the high camp, asked us with doleful countenance to send to the Mir for another bearer, although he knew no such servant existed in the Mir's dominions, and permit him to return, *via* Nagar, to Kashmir. The reason he gave for thus wishing to divest himself of the duties of his position was, that his health was suffering from the want of fresh vegetables, not procurable where we were. Well knowing his real reason was that he had had enough of high mountain life, we laughed at the idea of another bearer from the Mir being available, and told him

he must follow us over the Hispar Pass into Baltistan, where he would find the desired vegetables. He never mentioned the subject again, and not only remained with us to the end of the expedition, but returned to India in our service the following autumn.

CHAPTER VIII

New Lambardar and Coolies arrive—Adventures of our Agent—Coolie-Peculiarities and Practices—Measurements of melting Névé—Savoye despatched to examine Region at Head of Biafo Glacier—We explore high Snow Region north of Hispar Pass—Savoye's Report—Preparations to cross Hispar Pass to Biafo—Passage of Pass—View from Pass—Altitude of Pass.

It was fortunate we had lost no time in making the ascents described in the last chapter, or in returning from the high camp, for the storm which overtook us and in which we marched back to Base Camp lasted with little intermission for seventy hours. When it ceased, two feet of snow lay outside the tents, and the whole ridge presented a mid-winter appearance.

On our return we found a new lambardar and forty coolies had been sent up by the Mir to relieve the others. This number was not sufficient to carry on the varied work on hand for the next ten days, and to supply the topographers now working at Lower Base Camp with the extra coolies they needed. To secure the seventy coolies required,

the two lambardars were ordered to select thirty of the old set to remain, though none of them wished to do so, having evidently no fancy for further snow-work. The names of those selected were checked, the departing lambardar received an order for payment of himself and the coolies who accompanied him, and he and the discharged coolies left the next morning for Hispar. Forty empty gunny grain-sacks were entrusted to him to take down to our agent at Hispar.

The agent had a number of adventures on the path between Nagar and Hispar and while at the latter place. While traversing the Hopar glacier-tongue, he on two occasions narrowly escaped showers of falling stones. On his return to Nagar he found the bridge over the river swept away, and was obliged to take a steep and difficult route over pathless mountains to reach Nagar. While at Hispar, on taxing a Nagar lambardar with the non-delivery of three sacks of ata entrusted to his care, which were never accounted for, the lambardar threatened to burn the house he was using for storage over his head. When the lambardar and coolies, stated above to have been sent to him by

us, arrived, they presented our chit for the payment of their wages. After their identity was established, the amount due in full to the time of their arrival at Hispar was handed to them, but the lambardar refused to accept it, unless two days' additional wages for the whole twenty-six men for bringing down the forty empty gunny-sacks, which made only a coolie-load and a half, was also paid. The agent, of course, declined to accede to this demand, telling the lambardar that the full payment of himself and the coolies to the time of their arrival at Hispar after being discharged by us covered, eighteen times over, the amount that any coolies could demand for bringing down that load and a half.

The lambardar and coolies now went away, but later the former returned with twenty coolies armed with sticks, and threatened to kill the agent if his demand was not complied with. The latter had no means of defence except a large knife, but seizing this, he went to the door of the house and said: 'I am an old man, and have only a few years to live. You can kill me if you will, but before you do it some of you will bite the dust.' The village-

Telephotograph from cairn above Upper Base Camp down Hispar to mountains west of Makorum glacier. Behind these rises summit of Pyramid Peak at head of Chogo Lungma glacier, ascended in August 1903 by Dr. Workman, Petigax, and Savoye, to altitude of 23,394 feet. Distance of Pyramid Peak from camera about thirty-six miles ; of mountains in front of it about twenty-four miles.

lambardar, who was in the house with the agent, now called to the Nagar lambardar outside, ' Have a care, the Sahib has a dagger.' This had its effect on the really cowardly lambardar and his Nagar coolies, some of whom, perhaps, remembered the fighting qualities of the white men who, in the face of great odds, had captured their apparently impregnable defences sixteen years previously. They ceased their threats and soon retreated. This was the same lambardar who, after leaving Nagar, had demanded payment for the wood collected and for fifteen coolies alleged to have repaired the path. In a letter to us a day or two later, the ex-police officer wrote he would be thankful when he had ' seen the last of the devil-populated land of Hunza Nagar.'

We called Upper Base Camp also Coolies' Paradise Camp. As at Lower Base Camp, the coolies built for themselves quite a village of substantial stone huts, about as comfortable as those they usually occupied in their own villages. During the sixteen days passed at this camp, three sets of coolies came to it. Many of these were engaged in performing the work for which they were paid. Not a small

number, however, though they drew their rations daily and were always on hand with a scrupulous regularity to receive them, never did any work from the time they set foot in the camp till they left it two weeks later. A few of these had wounds on their feet, which really rendered them incapable of doing any work. Whether these wounds were self-inflicted or resulted from accident could not be determined. Others feigned illness, though such indisposition did not prevent them from drawing and consuming their rations. Others still, when any service was to be performed, hid themselves and were not to be found. Such coolies appeared to lead a life very satisfactory to themselves, for they had abundance of food, which, judging from the accounts received, they had not had for a long time at their homes, were well housed, did not suffer from cold or weather, and received the same wages as those who did the hardest work.

A similar disposition was shown, while we were at this and at Lower Base Camp, by many coolies, who, on being sent down to Hispar to fetch supplies, refused to return, either pretending to be ill, or

Face of southern wall of Hispar about two miles east of Alchori Col. Note its shaggy, broken condition, the horizontal stratification of its ice, the flutings of its névé, and corniced upper edge with sculpturing beneath it. Telephotograph from Upper Base Camp, five miles distant.

saying they had completed their term of service, or simply deserted without presenting themselves to the agent at all. This caused much inconvenience and delay, as coolies could not readily be obtained to replace them, and the number remaining at our disposal was at times so diminished as to be unable to carry out properly what we had planned to do.

Another coolie-practice, which caused not only additional expense but also tended to upset all calculations and limit our freedom of action, on account of the difficulty it entailed of estimating the necessary amount of supplies, was the pilfering of coolie-food by those engaged in transporting it. Each sack of ata when despatched from Hispar was weighed by the agent, and known to contain sixty pounds. When the sacks reached us, they were found to be short of that weight by ten to twenty pounds each. Scarcely a sack during the summer, other than those we brought originally with our personal caravan, was of full weight when it reached our camp. It made no difference whether the coolies who brought it were accompanied by a levy or lambardar or not; the result was the same.

This afforded fairly good evidence that elevating a coolie to the position of lambardar does not change his nature. If these people collected and preserved the amount they stole, they must have laid by a substantial store of provisions against future 'rainy days.'

The methods employed to pilfer grain and ata without untying the mouths of the sacks are mentioned in *Ice-Bound Heights of the Mustagh*, p. 249. In spite of this, the very coolies who were guilty of pilfering would demand their full seer of ata when the daily rations were given out. We will not weary the reader by recounting other ingenious devices of the Nagar men to make the most of this rare opportunity, but will only add that, altogether, in our experience of six expeditions with coolies, we have never met the equal of the Nagar coolies for malingering, shirking work, deserting, demanding double rations, looting grain, and mutinying. If the reader thinks that the Nagaris come in for a large share of attention in this book, he must remember that the province of the explorer is, among other things, to chronicle for the benefit of others the ethnological peculiarities of the inhabi-

tants as well as the features of the regions he investigates.

On our first ascent of the Kanibasar glacier, the upper surface of a large, flat boulder, at an altitude of 16,486 feet, was just emerging from a bed of old, consolidated névé. Ten days later, on our second ascent of the glacier, although in that interval the sky had been a good deal obscured by clouds and considerable snow had fallen, the same surface was found to be twenty-seven and a half inches above the névé. This difference of level represents the actual amount of melting of the névé during that time, or 2·75 inches per day, as the lower surface of the boulder was still deeply embedded in the névé, and the sun's heat could not affect the névé beneath it so as to cause it to settle. All the snow which had fallen on the névé was melted as well, and this additional melting, the amount of which we had no means of judging, would represent, had the weather been better, a greater disappearance of the névé.

Our interest in the daily amount of melting which hardened névé-surfaces undergo during the warm season being aroused by the above observation, a

stake was inserted in a bed of consolidated névé near Upper Base Camp, at an altitude of 15,900 feet, at twelve o'clock noon, 31st July. On 4th August at the same hour, the névé had melted 10·25 inches, or 2·56 inches per day, the last thirty-two hours the sky having been obscured by clouds.

On 5th August, at 2.30 P.M., the stake was again inserted in the névé near the same place. On 10th August, at the same hour, measurement showed the névé to have disappeared to an extent of 16·25 inches, or 3·25 inches per day. The sky was clear during this time. In all three cases, the névé froze soon after sunset, and at sunrise would bear without yielding the weight of the heaviest man. In all three it was clean and white. Had it been discoloured from an admixture of dust, the rate of melting would probably have been greater.

The daily average of these three observations was 2·85 inches. As, during a considerable part of the time covered by two of them, the sky was obscured, this figure represents, apparently, a conservative estimate of the average daily melting that would occur during the summer months at

the observation points. These were not very far below the snow-line of the region, and as the conditions obtaining at them did not differ essentially from those for quite a distance above and below, the above daily average may be taken as a fair standard of the melting which occurs over a large portion of the upper part of the Hispar glacier, all of which lies below an altitude of 17,500 feet.

Assuming the daily rate of melting for the months of June, July, and August, to be 2·85 inches, the amount of névé that would disappear during this time at about the altitude of the snow-line would be 21·85 feet. This leaves out of the account the considerable melting which must occur during the months of May and September, when the sun shines with almost equal power. The melting during these two months ought to offset any increment to the névé from summer-storms from May 1st to September 30th, so that a diminution of 22 feet in the thickness of the névé at or near the snow-line during the summer would appear to be a reasonable deduction from the results of the above observations. The melting of recent, soft snow, that has not been consolidated into névé proper, would, naturally,

take place at a more rapid rate, while clean, uncovered glacier-ice might, perhaps, be more resistant to the effects of heat.

A part of our plan on this expedition was, after we had finished our examination of the Hispar region, to cross the Hispar Pass and descend the Biafo glacier into Baltistan. This had been discussed with Sher Mohammed and the Mir, who promised to send up coolies and a good lambardar to go over the pass and down to Askole with us. In preparation for this journey, or with a view to vary our plan by pushing through from one of the sources of the Biafo to the Punmah glacier, should a passage suitable for coolies be found, Savoye and a porter with twelve coolies were despatched on 7th August to cross the Hispar Pass and descend the western head of the Biafo to Snow Lake, where they were to camp, setting up an extra tent, in which five sacks of ata, together with five loads of wood, should be left. The next day, with five coolies carrying their tent and necessary luggage, they were to penetrate the snow-bound region behind the high peak B15 as far as possible, camp, and from there try to find a passage to the Punmah.

Passage in centre of ice-wall extending across Névé glacier. Gradient of over 60° appears flattened from upward pointing of camera. Four coolies glissading down; two landing at base. Steepness of gradient apparent from shadows of three uppermost coolies.

Meanwhile, as the great, snow-covered plateau north of the Hispar Pass between the Watershed Peak and Upper Base Camp had not yet been explored, we ourselves started out with our first porter, Rey, and another porter, two servants, and fourteen coolies carrying light tents and three days' provisions, to examine it. Descending the moraine to the glacier, we crossed the ice-stream of Last Moraine glacier, which joined the Hispar directly above the camp, and keeping on the north side soon came to a large, névé-covered glacier, or branch, in reality the highest branch, which pours down into the Hispar in steep slants and ice-falls from a wide valley lying between a series of high mountains on the west and the great, white striated arête, or *contrefort*, descending from the Watershed Peak. The ascending, undulating surface of this glacier was followed up for more than three hours, when we came to a very steep wall of snow several hundred feet high, which ran clear across the valley in two convex bosses. In the centre, between these, a narrow slope with a gradient of about 60° led up to the top of the wall.

We reached this wall a considerable distance

ahead of the coolies. As on the occasion of the ascent of the Watershed Peak, we feared they would refuse to go beyond this point, but we adopted the same tactics, and pushed up the wall in zigzags without delay, to show them it was climbable and that we made nothing of it.

Above this the névé stretched away in rising slopes several miles to the north behind the Watershed Peak. We followed it up till noon, when we reached a large, rounded snow-hill in its centre. Here we stopped for lunch, and, as the coolies were nowhere to be seen, Rey went back to find out what had become of them. Here we waited till two o'clock in the fiery sun, which burned from a cloudless sky. The direct heat and that reflected from the dazzling, white surface were so intense that we had to cover our heads with woollen shawls for protection. At two o'clock Rey was seen approaching with several coolies. When he arrived, he said he had to return to the top of the snow-wall. A few coolies had surmounted it, others were half-way up, and two still remained below. After encouraging them by telling them the way above was good and only a short distance remained to go, and helping

Camp on Névé glacier at 18,324 feet, beneath point where north-west contrefort of Biafo Hispar Watershed Peak turns to south-west. Apex of peak in distance at right above contrefort.

them, all were finally brought to the top and started forward.

It was now so late and the snow so soft that we were obliged to camp just beyond at 18,324 feet. The snow was trodden down and the tents put up. The next morning we started without the coolies, in a temperature of 8° Fahr., to go to the upper end of the glacier, some three miles distant, and to ascend a snow-peak at its head, which would give a view of the region to the north. Notwithstanding the low temperature, the snow was not well consolidated. The surface was hardened into a thin crust, through which our feet broke every three or four steps and sank into powdery snow, the crust catching them as in a trap, so that an effort was required to extricate them. This soon proved fatiguing, and, with the altitude, made progress very slow. We had neglected to bring snow-shoes, the use of which would have greatly facilitated our movements. This and another, later to be described, were the only occasions during the whole summer when snow-shoes could have been used with advantage.

As we went on, the snow grew more unfavourable,

and it soon became evident the ascent of the peak, still a good distance away, was out of the question, as the snow-conditions were sure to be still worse on it, and neither time nor strength would be sufficient. Still, the main object of our visit to this upper snow-region, to ascertain its conformation and relation to the Hispar, had been accomplished. The upper end of the glacier, as was also the case with the Hispar, was formed by a snow-ridge which ran directly across it at an altitude of about 18,600 feet, beyond which a slope descended to a great snow-basin, apparently entirely enclosed by mountains and without outlet, though it possibly has an outlet to the east between what appeared to be continuous walls into the north-east tributary of the Biafo. On account of the course of this glacier running diagonally behind Watershed Peak, and of the peculiarities of its formation, it is rather difficult to judge of its length. As nearly as we can estimate, its upper end is about eight miles distant from its opening into the Hispar. As nothing more remained to be done, we returned to camp, and on the same day descended to Coolies' Paradise Camp. This glacier, being covered with

névé from its sources to its junction with the Hispar, was named Névé glacier.

On coming in sight of the Hispar, we saw Savoye's party far ahead of us also returning from their reconnaissance. After our arrival, he reported that his coolies went over the pass and down to Snow Lake well enough, but the next morning, when he attempted to move his camp farther with five coolies, in order to carry out the plan that had been drawn up, not a coolie would stir. Accordingly, he started with the porter at six o'clock, and ascended the east glacier behind B15 nearly to its end, which was found to be closed by an unscalable wall. The glacier, throughout nearly its whole extent, was covered with soft snow, and they were obliged to use snow-shoes, which they had taken care to bring with them. They then turned aside up a north branch of the glacier, and ascended a steep col at its head deeply covered with soft snow, into which they frequently sank above their hips. From this they saw a glacier descending in the direction of the Punmah, as placed on existing maps, which was also seen from the peaks ascended at the head of the Hispar, but it did not appear to be accessible from

this col, and certainly would not be to coolies, even if they could be got up the glacier to it. They reached their camp again at midnight, their feet so encased in ice that the snow-shoes had to be melted from their boots over the stove. Savoye estimates the length of the Biafo east branch at fifteen miles. The tent containing the ata and wood was left where he had placed it.

His report made it clear that we could not get through to the Punmah, and that the only route to Baltistan was down the Biafo glacier. Last Moraine glacier, which joined the Hispar directly behind Upper Base Camp, was the only remaining north branch. Though not a large or long glacier, it was rather an interesting one, and its upper half offered some good ice-fall climbing. The morning after our return, Mrs. Bullock Workman with Savoye and two porters visited it, and ascended a difficult ice-fall at its head.

Our work on the Hispar being now practically accomplished, we turned our attention to preparations for departure. The lambardar at present with us, who, we understood, was sent up to go over to Askole, had shown himself in the highest

Ascending ice-fall at head of Last Moraine glacier.

degree inefficient and untrustworthy, and we hesitated to undertake with him what, so far as the coolies were concerned, might prove to be the most trying move of the whole expedition. An urgent letter was therefore despatched to the Mir, requesting a reliable lambardar and a new set of coolies, to be sent up by double marches. A substantial stone-cairn was built on a shoulder of the mountain directly behind and 220 feet above the camp, and a record placed in it. Our baggage was carefully looked over, and all unnecessary articles, such as Mummery tents, extra Alpine rope, snow-shoes, and superfluous supplies, were taken out to be sent down to Hispar, only those things being reserved to be taken with us that were necessary for the further journey. All arrangements having been completed, we only waited for the arrival of a new lambardar and coolies and for favouring weather.

On 14th August, two porters with fifteen coolies were sent over the pass with ten sacks of ata and five loads of provisions, to be added to the articles left by Savoye in the tent at Snow Lake. We calculated that the fifteen sacks of ata thus sent

ahead would be sufficient, with the rations carried with us, to last the coolies to Askole.

On the 15th, another levy with forty coolies arrived. Supposing this reinforcement to represent the lambardar and coolies we had written for, we determined to lose no time, but start the next morning with his forty coolies and thirty of the others already with us, sending the unsatisfactory lambardar and the remaining coolies down to Hispar with the baggage no longer needed. Order was given to have seventy coolies ready at daybreak with three days' cooked rations.

The next morning at six o'clock but few coolies were to be seen. The lambardars were called, and asked why the coolies were not on hand. They replied they were cooking their rations. The lambardars were told to make them complete their preparations with despatch, as we must start soon if we were to get over the pass that day. By half-past six about fifty coolies came up and received their loads and glare-glasses, but the remaining twenty did not appear. Commands were now urgently pressed home on the lambardars to produce

Stone-cairn built on mountain-shoulder above Upper Base Camp.
Peak across Hispar overhangs Alchori Col on east.
Alchori Col on skyline at right.

the twenty forthwith. They and the khansamah went down to the coolie-quarters and dragged forth a dozen unwilling wretches, whom they drove before them with their sticks to the spot where we were waiting. They came limping up, and fell at our feet, complaining of various maladies, whining, and saying they were too ill to stir. Two, who were really incapacitated by wounded feet, were dismissed. The other ten, under vigorous application of the lambardars' sticks, which, in some quarters, would have been considered highly cruel treatment if administered by Europeans, were loaded and bundled off in charge of a servant to join their more active companions already started on the glacier. The khansamah and lambardars now returned to seek ten more to make up the quota, and, after prolonged search in the huts and among the neighbouring rocks, unearthed eight, who had hidden themselves away. These were also driven up and loaded. It was half-past seven before the last coolie left the camp. It may be added that, after they had found out that shamming was useless, and had actually started, all the symptoms complained of by those who had been so ill disappeared, and not one of

them was ever known to be ill again on the journey to Askole.

The day was cloudless, and the caravan made good progress over the well-frozen surface up the great névé-hills rising here, for the first time on the Hispar, steeply one above another. We kept to the north side of the glacier, to avoid the ice-falls into which the greater part of its stream is here broken, and ascended between these and a second set tumbling down from the great expanse of its northern reservoir. Above the ice-falls we came to the vast plain of driven snow extending the whole width of the glacier, which sloped up gently and almost imperceptibly to a snow-ridge running north and south directly across the glacier. This plain constitutes the Hispar Pass. The ridge, which is the highest part of the plain, forms the summit of the pass. After we had advanced a considerable distance over the great expanse of unbroken snow, the summit seemed to be no nearer, but rather to recede. Also, although its gradient was so gentle and even, and although the altitude was under 18,000 feet, walking over it was unusually fatiguing, probably on account of the monotony of its surface,

Caravan approaching Hispar Pass near upper edge of ice-falls; altitude about 17,000 feet.

which brought the same muscles constantly into play.

The view from this pass discloses a most remarkable scene of snow-beauty and snow-desolation. There is snow everywhere, almost nothing but snow to catch the eye. The great plain itself, and the huge walls, ridges, and peaks, surrounding it, are all deeply buried in snow. Only here and there rocks are seen on the mountains, which serve to heighten by contrast the impression made on the eye and mind by the vast pall of white that covers everything.

Near the west end of the plain stood a stake bearing an Italian and a Swiss flag, placed there by our topographers, who had been working at this point the preceding week, to mark their highest station. We left these patriotic emblems of their visit to take their chances with the winter snow, which would soon enfold them in its cold embrace. Whether the returning summer sun set them free to wave in the wind again, or whether, as is perhaps more probable, they are now buried, and will be carried down by the glacier, wrapped in its icy mantle, to reappear at some lower point, the future may possibly reveal.

We reached the summit of the pass towards noon. The sky was cloudless and the view perfect both to east and west. East we looked down the western head of the Biafo upon Snow Lake, and its eastern, snowy branch sweeping away behind B15. The north face of the turreted massif of B15, with the glaciers flowing down from it to the east branch, was very imposing, though the effect was marred somewhat by distance.

The view down the Hispar is not nearly so impressive as that down the Chogo Lungma from the high mountains at its head, on account of the absence of the contrast afforded by the remarkable, median moraines of the latter. The white surface of the Hispar and the white southern wall adjoining it flatten the field of view, obscuring outlines and details.

The altitude of the summit of the pass toward its south side, as calculated by the readings here and at Gilgit, is 17,500 feet. This agrees closely with the altitude of 17,475 feet we assigned in 1899, from the readings of two aneroids, to a point on the pass about a thousand feet north of that where the present readings were taken. The 1899 point

View west down Hispar from beginning of Hispar Pass just above ice-falls, at altitude of about 17,400 feet. Moraine-covered hillock-area coming from Kanibasar and Jutmaru streams seen at right edge of glacier. Snow-peak at extreme right is, probably, Kunjut No. 2.

appeared from where we stood to be somewhat lower than the 1908 one, but how much lower could not be judged by looking over the flat snow-field. As these points are situated on snow, probably the altitude of either of them would vary somewhat in different years and at different seasons. Conway places the altitude of the pass-summit at 17,650 feet, the point where he crossed it, as shown on his map, corresponding nearly with ours in 1899.

The place where we now stood was just below the lower limit of avalanches, which had been hurled down from the corniced brow of the great, white wall directly above, and we did not consider it safe to remain there long, for no one could tell at what moment an avalanche of giantic size might be precipitated from those heights, which would sweep farther than its predecessors and overwhelm us. And so, although we would have liked to linger the whole afternoon to enjoy the grand panorama, we turned our backs upon the snowy Hispar, where weeks had flown as days, and stepped down into the region of the Biafo. We thus, metaphorically, met our old footmarks of nine

years before on the pass, as we had assured the ex-police officer we should, and followed them down the west arm of the Biafo to Snow Lake lying below.

CHAPTER IX

Coolies Mutiny and compel us to Camp—Messenger from Mir arrives with Letters, which cause Coolies to become obedient—Snow Lake—West Biafo Wall—Savoye's Watch goes wrong—We descend Biafo—An early Camp—New Lambardar arrives—Descent continued—Tracks in Mud—Camp on dry Bed of Lake—Features of and Formations on Glacier.

An hour's descent of the steep, névé-covered slope leading down from the pass, and another of the more gently descending, broad glacier leading from its base, brought us to the head of the large, glacier-filled amphitheatre, which has been called by Conway and ourselves Snow Lake. Here the tent and supplies were found which had been left by Savoye.

On the west side of Snow Lake the Biafo wall projects into the glacier in a sharp promontory, and changes its direction from east to nearly south. It was our intention to round this promontory and descend the west side of the Biafo for about an hour to find a sheltered position on the ice for a camp, and orders were given the lambardar to bring the coolies after us. But the next hour showed us this

intention could not be carried out, and that, in spite of the presence of a new lambardar, we were not yet free from coolie-disturbances. The coolies followed well enough till they came to the tent, the sight of which, as we feared it would, seemed to exercise a sinister influence on their minds, for here they stopped and refused to move on, saying we must camp.

A more unfavourable spot for a camp could not well be chosen. It was at the meeting-point of four great glacial bodies, and wind-swept from the Hispar Pass and from various openings of Snow Lake—in fact, a perfect trough for gales to revel in. Should a storm break upon us, the tents would probably be carried away and the whole party might perish, as a party from Nagar is said to have done not far from the same place many years ago. The lambardar was told to explain this to the coolies, and tell them that we only wished to march a short distance farther to a sheltered position. The lambardar who, as well as the Europeans and servants, saw the foolhardiness of camping there, did his best to persuade the coolies, but they remained obdurate, and refused to stir.

Descent from Hispar Pass on Biafo side. Snow-ridge running from north to south forming summit of pass seen on skyline, continuous at left with a snow-arête of south Hispar wall.

He expostulated. They became excited, and all began to talk at once. The porters and servants catching the excitement, now joined in. One porter addressed a group of stupid coolies in Italian, another held forth in French, while the servants attacked them in Hindustani. It was really amusing, as we stood by awaiting the issue, to listen to the babel of tongues that emanated from the surging mass.

But the matter was becoming serious. Time was passing, and they would listen to no one. The lambardar took the usual last resort, and applied his stick to some of those within reach; but this did not have the customary effect, for with yells of rage the coolies swooped upon him, knocking him down in the snow. He picked himself up, apparently unhurt, and returned to us. They now all threw down their loads and retreated some distance toward the pass, saying they would return over it and leave us.

The prospect was bad indeed. We were to be left helpless on this exposed and dangerous spot, with thirty-seven or more miles of glacier either way separating us from the first outposts of human

habitation. It was most important that the coolies should be pacified and brought back, even if we had to camp at this bleak spot at over 16,000 feet. Therefore the lambardar, who had recovered his equanimity, and Savoye went to them and told them we would camp. Meanwhile the rest of us and the servants proceeded to pitch the tents on the soft snow near by.

After a while the coolies slowly returned, though sounds of dissension were heard even after the tents were up, and we greatly feared they would depart the next morning. Late in the afternoon a man was seen hurrying down the slope from the pass. He was a messenger from the Mir, and brought two letters in large, official envelopes. We hailed the black H.M.S. initials on them with delight, as we tore them open. One was from Sher Mohammed Khan, stating the Mir was sending his Prime Minister, the Wazir with more coolies, and his son, a head-lambardar of Nagar, who would cross the pass with us and see that we had no more trouble with coolies. The Wazir was to go to Upper Base Camp and remain there till we reached Askole.

The other letter from the Mir substantiated the

first, and contained threats of punishment to all disobedient coolies. These letters were in reply to our urgent one from Upper Base Camp intimating that affairs were not being properly conducted by the acting lambardar, and requesting a more honest and efficient one. It had been expected the Wazir would reach Upper Base Camp before we left, and this would have been the case had we waited another day there, which we should have done had we not supposed the lambardar now with us was the one sent to accompany us over the pass. The messenger said the Wazir's son would follow on and overtake us.

Sher Mohammed Khan further wrote that the Mir meant to assist us to his utmost, but, unfortunately, many of his subjects were not any too trustworthy (as we had already abundantly found out), and did not carry out his desires when at a distance. We have every reason to believe this to be quite true, and that the many annoyances experienced from his unruly subjects were due entirely to their own initiative, contrary to his orders. Our warm thanks are due to him and the Government behind him for repeated assistance during

the expedition, without which it could not have been carried out.

The news from Nagar spread rapidly. The coolies were told by the lambardar that the Wazir himself was coming to punish them. The wrangling and discord ceased immediately. They became docile, and, at last, peace, though not comfort, reigned over the wind-haunted basin. Blasts shook the tents the whole night, and drove the cold into them more effectually than had usually been the case at much higher camps. The altitude of this camp was 16,120 feet.

Snow Lake has been mentioned several times. This is a large, glacial amphitheatre formed by the meeting of four glaciers—the Biafo, and three unnamed tributaries. It may be regarded in two ways: (1) either as a basin serving as the head of the Biafo which descends from it, and itself receiving three large branches, one from the east behind B15, a second from the north-east, and the third from west-north-west coming from the Hispar Pass; or (2) as a part of the main stream of the Biafo, which glacier, ascending from south-east to north-west, receives the two branches descending from the east

East head of Biafo ascending beneath B 15.

Biafo glacier.

Apex rock-promontory.

South Hispar ice-wall descending to promontory.

North-east head of Biafo ascends behind this peak, its junction with Snow Lake only being seen.

Snow Lake.

Extremity north-east-south-east contrefort, Biafo Hispar Watershed Peak.

View of region around upper half of Biafo glacier and its three head-branches, from summit at 19,500 feet overhanging north-east head. West-north-west head of Biafo descends from Hispar Pass between observer and base of South Hispar ice-wall, between extremity of contrefort and rock-promontory. The upper portion of the massif of B 15, 23,914 feet, as well as summits of several peaks of Biafo west wall, are hidden from view by clouds.

and north-east respectively, and turns around the promontory projecting from its western wall, and ascends still further from east-south-east to west-north-west to the Hispar Pass, where it joins and is continuous with the Hispar glacier. The latter view, which makes the Biafo glacier originate in the Hispar Pass, receives strong support from the topographical features of the region. The western Biafo wall, running up from the south-east and curving suddenly to the west at the head of the so-called Snow Lake, ascends without a break to the Hispar Pass, where it is continuous with the great, snow-covered wall forming the southern barrier of the Hispar. The glacier descending from the Hispar Pass on the north and east side of this wall has the width of the Hispar at the pass, and essentially that of the Biafo below, and, if a line be drawn from the extremity of the rock-shoulder on the north of this glacier at its junction with the north-east branch to a similar extremity marking the junction of the eastern branch with the Biafo, the course of the Biafo is complete. The junction of the two branches with the Biafo in one common opening greatly enlarges the width of the Biafo

at this point, or of Snow Lake, whichever it may be regarded, in the same manner as does the junction of any large branch with a glacier.

As has been mentioned, the western Biafo wall descends from the Hispar Pass to the promontory, where it changes its direction from nearly east to about south-east, and descends farther with the Biafo glacier for some fifteen miles without any opening or being pierced by any branch. Sir Martin Conway on his map of the Hispar glacier indicates a large branch-glacier as entering the Biafo or Snow Lake from the west, just south of the promontory, and has also placed himself on record as asserting the same glacial connection in writing, in the July 1908 *Geographical Journal*, p. 72. Careful observations at this spot made by us on three expeditions from three directions, verified by photographs, prove that the wall here is continuous, and that no such branch enters the Biafo. Sir Martin has since admitted (*vide* Feb. 1910 *Geographical Journal*, p. 129) that when he passed the spot the mountain-wall was hidden by clouds, beneath which he thought he saw a glacier. What he probably saw beneath the clouds or mist was the névé and

Point, or promontory, where south Hispar wall, of which two snow peaks are here seen, descending at right, turns sharply and forms west wall of Biafo, unbroken at this part. West-north-west head of Biafo descends between sharp rock-point and opposite mountain face, the extremity of contrefort, at extreme right. Two snow-peaks in centre face Hispar Pass on their north side.

avalanche débris, which fills the recesses at the bases of the rock-peaks opening on the glacier.

The two east and north-east branches entering the Biafo at Snow Lake ramify into many smaller branches among the multitude of peaks that cluster around and form the Biafo watershed, and drain a large area.

As ill-luck would have it, Savoye's watch went wrong that night, advancing several hours, and he called us at twelve-thirty instead of four-thirty A.M. Supposing, in the semi-darkness of candlelight, our watch, which indicated the preceding figure, to have stopped, and unable, on account of the whistling of the wind, to hear the sound of its movement, we got up, dressed, had coffee, and were preparing to leave, when the continued obscurity without, which had not given way to dawn, as it should, aroused our suspicions, and led to the discovery of the mistake. Although all returned to sleeping sacks again, between this interruption and the howling of the wind there was no more sleep. At seven-thirty we were off again for the descent of the Biafo. For several miles the névé-surface was very rough, and covered with rounded elevations arranged

rather largely in lines, their appearance suggesting that they were the degenerated remnants of a vast field of nieve penitente. These made walking difficult and fatiguing. In 1899 we found the surface at this point smooth and covered with a sheet, three or four inches deep, of water and slush.

One by one we passed the old familiar mountains, whose acquaintance we had made nine years before, unchanged in form and appearance, rising like huge teeth abruptly from the glacier, their vast, perpendicular ramparts scorning any snow-mantle except in recesses from which it could not be shed, in their rugged grandeur contrasting strongly with the ice-clad peaks of the Hispar. One of the party, probably in consequence of the exposure of the previous night, became quite ill on the rough downward march; so by noon we began to look about for a suitable place for a camp. A spot near the glacier bare of snow was at last discovered on a shoulder descending from a mountain on the west bank, and we accordingly steered for it. When we reached it, three small terraces were found among the rocks covered with dry earth and flowers, which, with a little levelling, made excellent places for tents.

Peaks forming east wall of Biafo glacier below Snow Lake, called on page 108 of *In the Ice-World of Himalaya* the Biafo Walhalla.

Good, pure water existed in abundance on the glacier near by, but wood was entirely wanting. The altitude was 15,100 feet. The condition of the member who was ill was such that we might be detained here several days. From previous experience we knew that dwarf-willows sufficiently large to serve as fuel could be obtained three hours' march lower down, at a spot which, under ordinary circumstances, could easily have been reached that day. The stupid and inexcusable conduct of the coolies in compelling us to make the exposed camp of the previous day was the cause of our now being brought into the predicament of being obliged to camp where there was no wood, just as all cooked rations were exhausted. The lambardar was therefore ordered to proceed at once down the glacier with forty coolies, find wood, and return the next morning, having every man well loaded. Meanwhile, two primus stoves were brought into action to supply the culinary needs of ourselves, the guide, and porters, after which they served to cook the chapatis of the servants. The coolies remaining with us found dried grass and plant-stems in sufficient quantity to make smoky fires and

tide them over till their *confrères* arrived with wood.

That evening the new lambardar, the son of the Wazir, arrived with three coolies, having followed us over the pass, as the messenger said he would. His eyes were bloodshot and inflamed, the pupils contracted, and he was nearly snow-blind, so that one of the coolies was obliged to lead him. He had come over without glare-glasses. He was at once provided with a pair of glasses and the means of treatment. In two days his eyes returned to a normal condition. He was quite a different man from the three lambardars who had preceded him; in fact, he was the only one who was fit for the work required by us. He was of a higher class than the others, was quiet and modest, but it was quickly evident that he was armed with an authority, either delegated or inherent in himself, which the coolies respected.

He proved to be an excellent fellow, and from the time of his arrival the coolies gave no further trouble, and would never have been recognised as the disorderly band which had given us so much inconvenience. Had he been in charge of the

coolies from the beginning, as should have been the case, we should have been spared many annoyances that proved both distracting and expensive. We have never known a better instance of the truth of our assertion, elsewhere made, that coolies require a master if efficient service is expected of them. Whatever may be said in favour of the abolition of *begar*, or forced labour, in Kashmir, it will be some time, we fancy, before such modern methods can be successfully adopted by the ruler of Nagar, whose unruly subjects are only amenable to force, being entirely above adherence to agreement.

The next day the coolies returned with a lot of green wood, which no one but themselves would venture to use on account of the infinitesimal amount of heat and dense smoke it gave off on any attempt to use it. They were permitted to appropriate the whole of it to their use, while the primus stoves continued to do service for the rest of the camp. We had now no longer any need of fourteen of the coolies, as the rations they carried had been used. Their further presence with us would only serve to diminish the remaining, rapidly dwindling supply of coolie-food. Also the lambardar

who had come over the pass with us, on the arrival of the last lambardar had become a useless encumbrance. So, on the second morning after the arrival at this camp, he and the fourteen coolies were despatched to Hispar with letters. On the third morning, the invalid having recovered sufficiently, the journey down the glacier was resumed. We followed the right, or west bank, marching leisurely, sometimes on the glacier and sometimes on the lateral moraines and lower mountain-slopes.

The hillsides were clothed with grass, flowers, and dwarf willows, as were also the ancient lateral moraines, which here, as on the Hispar, were large and high. Border-lakes existed at intervals all the way down the glacier, and we crossed the dry beds of several that had been drained. In the mud around these, tracks of bears, ibex, and other animals were constantly met with. At one place we followed for some time the tracks of a very large bear leading in the direction we were going. Every one would have liked to see the animal that could make such large tracks, though, as we were entirely unarmed, no one would have cared to meet

Large western branch of Biafo at its junction with latter, its edge folded up into hillocks by pressure. Note lateral moraine along its edge, portion of larger, older moraine at right, space between which and mountain-wall is filled with débris fallen from latter, and in angle between moraines a border-lake.

him at close quarters. A sharp look-out was kept for him, but he did not materialise.

On reaching a mud-covered depression some distance farther, one of the porters who was in advance called out, 'More bear-tracks'; on which a servant, who ran ahead to see, pointing to the tracks, exclaimed, 'Not bears, peoples.' And, to be sure, there were the naked footprints of what Savoye called 'les Askoliens,' three good marches up the Biafo, where one would not suppose the Askole people would ever come, for the way down the Biafo from here, either by the glacier or its banks, is exceedingly rough and difficult. Ever on the watch for wild animals, this was not the first time our European assistants had been on the wrong scent. We recall an occasion some years ago, when a noted guide, marching in advance, returned and warned us to change the direction of the route, as he had seen two bears just in front. Being sceptical, we went forward to look ourselves at the animals, which turned out to be two yaks calmly grazing. Had this been in the Alps, the mistake might have been attributed to the generous amount of alcoholic stimulant carried on mountain excursions. Not

far beyond the bear and ' peoples' ' tracks, we came on a well-preserved skull of an ibex with horns on which forty rings were counted.

We camped that afternoon on the rolling bed of a former border-lake which had drained away. The upper layer of mud deposited at the bottom of the lake was dried and cracked by the sun. It was not sufficiently thick to withstand much pressure, and, like a thin crust upon powdery snow, was easily broken, laying bare a stratum of dry dust beneath that did not contribute to the comfort of the occupants of the tents pitched upon it. This was the only available camping-place in the vicinity, the alternatives being the rough, crevassed, moraine-covered glacier, or the even rougher, splintered, rock mountain-slants.

Directly in front, cutting off the downward route in that direction, towered a high, steeply descending, shattered and crevassed ice-fall, in which the lowest, large west branch of the Biafo joined the main glacier. The séracs of the ice-fall were split into slender spires, which had been further sharpened by sun and heat into a series of giant nieve penitente-pinnacles of typical shape. Several of the pinnacles

Camp on dry bed of drained border-lake just above entrance of lowest, large, west branch of Biafo. Branch above camp descends in high, séracked, terraced mass of ice. Many of the slender séracs had been converted by melting into nieve-penitente-like pinnacles of typical shapes, especially beyond left edge here seen. Several had hoods of ice projecting from apices.

had hoods of ice projecting from their summits. Similar instances of sérac-nieve penitente were seen on other parts of the Biafo and on the Jutmaru and Kanibasar glaciers.

After the junction with the Biafo of its large branches in its lower half, the sides of the glacier are much broken into séracs, which are heavily covered with débris. As on the Hispar, the splintered ice rises high above the edge of the glacier-bed on the sides, and runs in straight lines between the entrances of the branches, depositing lateral moraines from the débris it carries. The present edges of the glacier lie at considerable distances, often several hundred feet, from the great primary moraines which mark the former limits of the glacier, and it is evident, as in the case of other Himalayan glaciers, that a recession in width and diminution in thickness has been in progress for a long time. Several lines of lateral moraines are also seen between the oldest and those lying next the present edge of the glacier.

Along the lines of the median moraines, in the lower half of the glacier and upon the white ice in their vicinity, lay countless numbers of rock-

boulders, around many of which the ice, having melted away, left them supported on ice-pedestals as glacier-tables. Where the boulders had slid from their pedestals, the latter had been sharpened off by melting into nieve penitente-pinnacles, often standing several in a group or in a line. In places the boulders were so thickly scattered about that one could not advance more than three or four yards in any direction without encountering one. There was also an abundance of nieve penitente on the same parts of the glacier below the névé-line, the pinnacles of which were covered with mud, sand, or gravel. These pinnacles stood alone, or in groups or lines, on level surfaces, in hollows, on the tops of séracs, and on hillocks. In places the glacier-ice was stratified in perpendicular, longitudinal strata, which passed up through the pinnacles, thus showing that the latter were formed from the ice of the glacier.

CHAPTER X

Lower Biafo Ice-Fall—Ledge Camp—Arrival at Askole—Nagaris fraternise with Askole Villagers—Nagar Coolies paid off—Carrying blindfolded Porter across Rope-Bridge—A Mountain-Route difficult and dangerous—Crossing Braldoh River on Zak—Inclement Weather on Deosai Plains—Gurais to Srinagar.

THE Biafo descends with a fairly even gradient from the base of its sharp fall from the Hispar Pass to a point about one march above the extremity of its tongue, where it is broken up into an ice-fall with large crevasses and séracs. When we ascended and descended the glacier in 1899, the crevasses at this fall extended transversely across the glacier from side to side, and the only passage we were able to find over them was at the centre, where, at the most difficult point, a precarious pathway had to be cut along a shelf above a profound crevasse, between two great séracs. On this occasion the crevasses ran diagonally, and were shorter, though still wide. With the ice-ridges enclosing them, they formed a labyrinth through which a

clear head and a knowledge of ice-craft were required to find a way. Here Savoye's skill as the possessor of both was apparent, as it had been in many a tight place before, and though we had to cross several very risky bridges, he led the way without once returning on the track with remarkable certainty and judgment through the maze of crevasses and séracs down to smoother ice at the base of the fall. The descent of the ice-fall occupied an hour and a half.

A short distance below the fall, on the west bank, lies a grass-covered maidan directly beneath a perpendicular rock-precipice, where we had made our first camp in 1899 when ascending the glacier. Here we camped again on the old ground, every feature of which was familiar and recalled experiences that had been long relegated to the background of consciousness by pressure of the events of four succeeding expeditions. This was the last spot above the tongue, several hours' march below, suitable for a camp. It was named Ledge Camp in 1899, and its altitude, as then measured by the readings of two aneroids differing only slightly from each other, without reference to readings at

Crossing ascending ice-bridge between two abysses of lower ice-fall of Biafo glacier.

a base station, was given as 11,777 feet. The boiling-point readings now taken, compared with simultaneous ones at Skardo, gave 11,743 feet. The close correspondence of the results obtained by such different methods is interesting. Souvenirs of our former visit were found, among which were two biscuit-tin covers still bright and unsullied by rust. A stone cairn was built during the afternoon on a rock-shelf above the summit of a high moraine just south of the camp.

Owing to the two days' delay at the higher camp, the supply of coolie-ata had run short, so that on this and the next day the coolies had to be content with half rations, which really was a matter of no consequence to them, as they had been overfed for fourteen days and had had easy marches. The half ration was more than they had been eating in their own villages for months.

The next morning at seven o'clock, rather a late hour of starting with us, leaving this our last glacial camp, we marched down over the broken and débris-covered lower part of the glacier to a point a mile and a half above its end. Here a path was discovered running up from the glacier-bank over the

mountains, which, we judged, would lead to Askole. We accordingly made for the right bank above which it ran, and, after breaking a way up 200 feet of a steep earth-slant denuded by a landslide, we reached the path, which wound upward for some distance along a sharp slope, and then downward for 2000 feet over rocks and sand to the Braldoh valley leading to Askole.

We reached Askole at 4 P.M. of 24th August. The sun was hot, and after leaving the glacier we felt the change from the upper, ice-cooled air to that of the dry, heated valley, which was not to be wondered at, for in fifty-two days we had never stepped off glaciers and mountains, and for forty-two we had camped and lived at an altitude of 15,000 to over 21,000 feet. Half a mile east of Askole village, nearly opposite the old fort, our full camp was pitched. Here double flies were again put into use as a protection against the sun, chicks, and the few requisites we had brought over with us of comfortable camp-life. The altitude of the camp, calculated by comparison with Skardo readings, was 10,300 feet. As soon as the Nagaris had deposited their loads, they marched into Askole

Ledge Camp, 11,743 feet. Note perpendicular rock-columns above camp, lateral moraine at left, and cairn built by us on shelf above it.

village fifty-five strong for a raid upon ata, ghee, and other simple food at our expense.

On our arrival the Askole lambardars, seven in number, were instructed to provide the Nagar coolies with full rations for this and the succeeding day on which they would remain in Askole, and also, that our agreement with them might be fulfilled to the letter, with an extra half ration for the preceding day when they had been on half rations. They did not need or deserve this last, as the failure of food was due to the delay caused by the consequences of their own bad behaviour at the head of the glacier. The Baltis are said to dislike and distrust the Nagar people, who formerly made incursions into and ravaged their country, but no rumours of discordant relations between the hosts and their guests reached our ears during the thirty-six hours' stay of the Nagaris at Askole. The villagers were evidently willing to supply their guests with everything they needed at their own prices, which we did not question, and the visitors were just as ready to accept all that was offered, and possibly they may have done a little bartering on their own account, as, on their departure, some of

them were observed to carry away sheepskins and other articles, which they did not appear to have with them on the march down the Biafo.

The next morning the fifty-five Nagar coolies were collected on the grass near the camp. Each was called up in turn, and in presence of their lambardar paid for the time he had been with us, as well as for six days allowed for return to Nagar over the Hispar Pass. Each also received six days' rations for the return journey. The rest of the day and the following night they spent in the village, and early on the second morning filed past our camp toward the Biafo. The lambardar and his three especial attendants returned *via* Skardo and the Indus valley to Gilgit.

At Askole the lambardar who had been with us in 1899 put in an appearance, looking somewhat more mature, but otherwise much the same. His name we remembered as Kinchen, probably a mistake, as now he answered to the name of Gallu. He appeared glad to see us, and was very friendly. He readily agreed to provide coolies to go up with us to do some climbing in the Skoro mountains,

Lambardar and Nagar coolies at Ledge Camp, Biafo glacier.

and to go over the pass to Shigar. He also agreed to go himself in charge of them.

Two days later we left Askole with fifty coolies to carry out this plan. When the jhula, or rope-bridge, was reached, a delay occurred owing to an idiosyncrasy of one of our porters. Although an excellent man on rock, ice, or snow, he was affected with uncontrollable vertigo when obliged to cross running water on a narrow bridge such as a tree-trunk or a jhula made of only three strands. How to get him over the swirling, boiling torrent of the Braldoh was the question.

It was evident from the first he could not cross the bridge alone. Savoye and another porter roped themselves to him, one in front and one behind, and the three started to cross, but as soon as they came over the edge of the river rushing by some fifty feet beneath he could endure it no longer, and they had to return. We now suggested that he be blindfolded and carried over on the back of a strong coolie. He was by no means a featherweight, weighing at least 180 pounds, and to submit to being carried over a jhula in this manner required considerable courage on his part, for should he

become panic-stricken and struggle, or lose his hold and fall, perhaps carrying the coolie with him into the torrent, nothing could save them. He, however, assented to the proposition, and search was being made for the strongest coolie, when one of our camp servants, a tall, slender fellow, volunteered to carry him over.

Savoye deemed it wise to use the rope again, so he and the porter to be carried and another porter behind were again roped together, leaving the servant free. The servant took the blindfolded porter on his shoulders, and, with Savoye in front and the second porter behind, they started. The questions that now presented themselves and caused us some apprehension were—would the bridge support the weight of four men at once; and could the servant, whose physique scarcely seemed equal to the task, hold out under his load for the 300 feet he must carry it, for it would not be safe to set the porter down on the bridge short of the farther end? Fortunately the bridge and the servant's strength both proved equal to the demand on them, and the passage was effected in safety.

The Skoro route was ascended to a grassy maidan

Blindfolded porter being carried across jhula bridge spanning Braldoh river by Indian servant.
Porter is roped to Savoye, who is leading, and to a second porter, who
assisting behind is concealed from view.

above the mountain-village of Thla Brok. Camping here, we were detained ten days by stormy and uncertain weather, during which no mountaineering could be attempted. On the eleventh morning, as no signs of improvement were apparent, and time was limited, we struck tents and descended again to the Braldoh valley *en route* to Shigar and Skardo. We had wished to avoid this route, which, as we took it, from the last Askole village to Tigstun, is the most difficult and disagreeable to travel over of any (pathless mountains excepted) we have met with in Himalaya.

The jhula was passed as before, and the right bank of the Braldoh river followed till we came to a second jhula near the village of Pakora. This jhula was narrower, not so strongly made, and not in so good a condition as the one near Askole. It swayed badly as two coolies crossed it. After inspecting it, we, the guide, and porters were all of the opinion that the danger of four men crossing it together, as would have to be the case in order to carry the porter over, was too great to be risked. The lambardar was therefore asked if there was not a route on the north side, where we

now were. He said there was, but it was exceedingly difficult and ran up and down over wild and broken mountains.

We asked: 'Can your coolies take the baggage over it?' He replied: 'Yes, if you give them time.' 'Very well; if the coolies can go, we can, so give the order to take this route,' we said. Within a quarter of a mile we had our first taste of the quality of that route, for it led directly to the irregular face of a high, perpendicular cliff, that could only be passed by ascending and descending on much weathered, roughly constructed, native ladders. Beyond this to Hoh it took us over an exceedingly broken and rough country, composed of ancient glacial deposit; under beetling precipices, often from 1000 to 2000 feet high, packed full of rocks and boulders cemented together with clay, sand, and gravel, a most unstable combination, which was constantly giving way and descending in deadly avalanches to the valley below; up through steep gullies washed out by torrents in the same formation; and over landslides of mud brought down by floods during the rainy season, banked up high on either side of watercourses. At one place we were obliged

Ascending rock-precipices by means of poplar-wood ladders, on route from Askole to Hoh.

to ascend a rock-packed mountain-side some 1500 feet to get above and around an immense gully or washout, which had been scooped out of the mountain by an impassable torrent, entering the river and cutting off the route that formerly ran along its bank. Path there was none. The way was wearisome and fatiguing even to trained mountaineers accustomed to unexplored, pathless mountain-regions, and there was ever the suggestion of danger from falling stones and slips that kept us constantly on the alert. From Hoh to Tigstun, near the junction of the Braldoh with the Shigar valley, the path was bad enough, but good in comparison with the preceding stretch.

On 10th September we reached Tigstun. It had been arranged that Savoye and the porters should leave us here to return at once *via* Skardo and the Deosai to Srinagar, in order to reach Bombay in time to take the Messageries Maritimes steamer, on which their return passage had been engaged, while we followed more leisurely. A messenger had been sent ahead two days before to Shigar to order a zak to meet us at Tigstun that morning to take us over the Braldoh river. On our arrival there were no

signs of the zak, and no one knew anything about it or the messenger who had been sent to order it. The lambardar, at our urgent request, sent two coolies to descend the sands between the streams in the Shigar valley to a point opposite the village of Yuno, from which they could call across the river to the Yuno people to send up immediately a small zak which they owned.

We camped to await its arrival. The next morning about seven o'clock four men were seen on the opposite bank bearing the component parts of the zak. Two coolies were despatched to the point nearest to them on our side of the river to call over to them to use expedition in setting it up, as time was of importance. Notwithstanding this admonition they proceeded to put it together in what seemed to us, as, chafing at the delay, we watched them through our field-glasses, a needlessly leisurely manner—two inflating the skins with their mouths applied to one of the projecting legs, and tying them to the poles with great deliberation, stopping every few minutes to inspect their work, while the other two assisted by smoking and looking on.

By eleven o'clock the zak was in order, and shortly

afterwards was brought over to our side of the river. As Savoye and the porters had been delayed twenty-four hours, they were told to use it at once to take them, their baggage, and coolies across, and we would wait till later. Owing to its small size it could only carry four persons besides the crew at a trip. We bade them good-bye and God-speed, and they embarked first, leaving their servant, coolies, and luggage to follow. The current was so swift that the zak was borne down the stream a quarter of a mile before it reached the opposite bank. Having landed, they sat down and waited for the other necessary trips to be made. To carry the zak up the opposite river-bank from the landing-place to a point an eighth of a mile above our camp, to cross over to the camp, take another load down to the landing-place, and to repeat the procedure several times, occupied a considerable interval, and it was not till 2.30 P.M. that all their effects were landed on the other side, when we waved a final adieu to Savoye and his party, as they took up their line of march for Skardo. The remainder of the afternoon was occupied in transporting our baggage across the river, and the following

morning we went over with our tents. A few days later we arrived at Skardo without especial adventure.

On 17th September we left Skardo, still in summer heat, to cross the Deosai Plains to Gurais on the Gilgit road. The variable weather of the last few weeks had brought autumn conditions earlier than usual on the high routes, and our first camp, at 13,000 feet below the Burji La, was made in a snow-squall, with cold, cutting wind, which so demoralised the servants dressed in thin clothing that they lost their heads and could not do their work. That night the minimum temperature was 18° Fahr. The next day the Burji La was crossed in deep snow, with a cold wind again blowing. The ponies sank to their shoulders in the snow, and several missed their footing on the steeper places and slid some distance down the slant. Packs had to be taken off and carried by the pony-walas, and the ponies assisted by four or five men. At last, after floundering for more than two hours in the snow on the north side of the pass, all gained the top, where the snow ceased. We camped that afternoon at about the same altitude as on the previous evening, also in

a snow-squall, and had the same minimum temperature that night.

On the third day's march, cold, boisterous winds and several snow-flurries were encountered. At six-thirty the following morning the thermometers registered 4° Fahr., a most unusual temperature for the season and altitude. We felt the severity of the weather the more, as mountain-clothing had mostly been sent around with our agent *via* Gilgit. The fourth camp was pitched in a blinding snow-storm, which covered the ground with a white mantle four inches thick in a short time. The minimum temperature that night was 7° Fahr.

The entire passage of the Deosai was thoroughly disagreeable. There was only occasional sunshine, and the ground was wet and boggy from frequent squalls. The ponies and pony-walas became used up from the wind and cold, and one of the latter became ill and had to be left behind at the Burzil Chowky. We were glad enough when at last the Gilgit road was reached.

At Gurais a pleasant, autumn climate was found. We camped there for a week, not wishing to reach Srinagar till after the 1st of October, when the warm

weather would be over. On 30th September, as we were starting to return, a hard rain set in, which turned to snow that night. The snowstorm lasted for fifteen hours, covering the earth to a depth of nine inches, and interrupting all travel and telegraph connection in both directions. The whole smiling route from Gurais to below Tragbal was converted into a wintry wilderness.

We waited till 4th October for the route to become passable, but even then were obliged to march in mud, slush, and on ice, for two days till beyond Tragbal. On the Radjiangan Pass four feet of snow lay on the long traverse at its top, and on the Kashmir side the mud was ankle-deep. We arrived at Srinagar on 8th October.

Thus closed our sixth season of Himalayan exploration, a delightful season in one of its grandest regions, from the memory of which trials and hardships fade away, leaving beauty, grandeur, and interesting experiences, alone shining clear.

Alluvial fan deposited by floods issuing from narrow gorge in mountains behind. For some distance edge of fan rests against Hispar tongue, the extremity of which is seen at right lower corner. Torrent from gorge has cut deep channel through centre of fan.

CHAPTER XI

Group of great Karakoram Glaciers—The Hispar and its Branches—Remarkable Southern Ice-barrier of Hispar—Hillock-Area—Hispar Pass—Reservoir—Glacier-Lakes—Absence of Crevasses—Pressure of Branches as cause of Hillock-Formation—Return Lateral Pressure wanting—Median Moraine Formation slight—Lateral Moraines—Intraglacial Moraines—Strata—Maidans.

HAVING conducted the reader through the various stages, and mentioned some of the incidents of the expedition, we would now call attention to certain prominent structural features of the Hispar, and their relations to one another.

The Hispar glacier is one of a group of four great mountain-glaciers, surrounded by many smaller though by no means diminutive ones, lying within a parallelogram bounded by 35° 40′ and 36° 20′ lat. N. and 74° 50′ and 76° 40′ long. E., in one of the most snowy of Asiatic mountain regions. Born amid the howlings of the tempest and the roar of the avalanche, in inaccessible fastnesses far above the habitations of man or animals, and fed by large tributaries, themselves glaciers of the first order,

these vast rivers of ice force their way downward through the intervals between precipitous mountains for many miles into the deep valleys below, where, succumbing to the heat there encountered, they gradually die out and disappear. The waters into which all of them are finally resolved find their way into that remarkable river, the Indus. The Baltoro and the Biafo discharge their waters into the Braldoh river, the Chogo Lungma into the Basha. The Braldoh and the Basha unite at the head of the Shigar valley to form the Shigar river, which enters the Indus near Skardo. On the contrary, the Hispar drains westward into the Nagar, which enters the Hunza river. This joins the Gilgit river, which finally enters the Indus north of Bunji.

These great glaciers are not mere bands of snow and ice running smoothly from their sources to their tongues, but they are most complicated structures, descending in steep, broken ice-falls covered with splintered séracs, or thrown up into huge undulations, ridges, and high hillocks, seamed by unfathomable crevasses, and bearing on their surface or within their substance an incredible amount of débris from the decaying mountains, whose crests they fringe

Extremity of discoloured, detritus-covered tongue of Hispar glacier abutting on left against large alluvial fan. Torrent issues from ice-cave on right side.

with fluted snow-ruffles, and whose flanks they rasp away and sculpture out in their downward progress. From the similarity of their environing conditions, these glaciers have many features in common, but each has also distinctive features sufficiently marked to render a comparative study of them all of engrossing interest.

The Hispar glacier is the most northerly of the group. Its tongue is first encountered a mile and a half east of Hispar village, at an altitude of about 11,000 feet. It is a broad, débris-covered, discoloured mass of ice, with irregular surface sloping down to the detritus-strewn valley-bed, where it ends. A large torrent, issuing from an ice-cave on its southern side, has cut a passage through the rock-débris to the valley below. This is joined at the extremity of the tongue by a smaller stream, descending in a sulcus between the north side of the tongue and the ragged edge of a large, alluvial fan radiating from a gorge in the mountains opposite.

From here the glacier ascends with a gentle gradient in a direction somewhat south of east for 36·63 miles to the summit of the Hispar Pass, lying at an altitude of 17,500 feet, where it meets the upper

extremity of the Biafo glacier. Drs. Calciati and Koncza consider the length to be 35·16 miles, which, as measured on the map, corresponds to the distance from the tongue to the point where their route-line ends. By repeated altitude observations while crossing the pass, Dr. Workman found the summit to be 1·47 miles beyond or east of this point, viz. at 36·63 miles.

At the summit of the pass the Hispar shades over, almost imperceptibly, into the Biafo glacier, the line of demarcation in places on the snowy expanse being difficult to distinguish. Indeed, the slope of the whole pass for some three miles is so gradual that it is difficult with the eye to determine where the highest point is. If the length of the Biafo, which has never been accurately measured, from the summit of the Hispar Pass to the extremity of its tongue be placed at thirty-seven miles, which would appear to be a conservative estimate, the total length of the great ice-band, stretching from shortly above the village of Hispar in the province of Nagar across the watershed down to within a few miles of Askole in Baltistan, is 73·62 miles or 118·51 kilometres, the longest extent of glacier

Lower twelve miles of great southern ice-barrier of Hispar, from Haigatum glacier to Alchori Col.
Moraines connected with ice-streams from wall at left.

outside the Polar regions. Drs. Calciati and Koncza mention this length as 106·625 kilometres or 66·23 miles, but not having visited the Biafo, they have evidently underestimated or been misinformed as to the length of that glacier.

The average width of the Hispar above the tongue is about two miles. In the lowest fifteen and a half miles of its course it receives on its south, or orographical left side, six branches, three of them large, the largest and highest of which is the Haigatum; but from this last to its culmination in the Hispar Pass no branch enters it on that side. On the north side nine branches, six of them large, enter it at various points, the highest being close to its origin. Many of these branches, especially the northern ones, are laden to an unusual degree with débris.

As already stated, the mountains enclosing the Hispar, especially the upper half, as well as its branches, are high, greatly broken, very steep, and heavily covered with ice and snow. Their crests and summits are largely crowned with huge, overhanging cornices, many of them of great thickness and stratified in numerous layers. These, when they

break away, give rise to avalanches of great size.

The southern barrier of the Hispar extends from the Haigatum glacier to the summit of the Hispar Pass, a distance of twenty-one miles without a break. It consists of a high, continuous wall, rising at intervals into sharp peaks, several of which are over 22,000 feet, the whole covered with snow, masses of ice, glaciers, and hanging glaciers, and surmounted by cornices, which frequently break loose and shower down avalanches on the glacier below. These avalanches score and chisel out its icy flanks into deep furrows, sharp ridges, battlements, and spires, which, combined with the frozen cataracts and flutings of the hanging glaciers, present a most weird and bizarre effect in the changing shadows which chase one another across the face of the wall, as the sun marks the hours in its westerly course. In our six expeditions in Himalaya we have seen no ice-expanse that approaches that of this wall in extent, complexity, and grandeur. On account of the size and frequency of the avalanches falling from it, its base cannot, at any point, be approached with safety. About three miles east

Upper ten miles of great southern ice-barrier of Hispar, from Alchori Col to beyond Hispar Pass. Part of Hispar ice-falls also seen. Avalanches and glaciers from this wall contribute materially to swell volume of Hispar.

of the Hispar Pass the wall makes a sharp turn to the south and continues on, also unbroken, as the west wall of the Biafo glacier for fifteen miles farther. It thus forms a continuous barrier forty miles in length unpierced by a single glacier, though extending through a region of snow and ice.

From near and behind the apex of the angle made by the wall at the point where it turns southward, a second wall runs west, south of, parallel to, and a short distance from, the south Hispar wall, cutting across the heads of the Sosbon and Hoh glaciers, and finally losing itself in the east barrier of the Alchori glacier. At the bottom of the narrow nala or gorge, enclosed between the precipitous faces of the second and the south Hispar wall, headed in by the Biafo wall on the east and the Alchori barrier on the west, lies a well-formed glacier, first discovered by us from the Col des Aiguilles, at the head of the Hoh glacier, in 1903. This glacier, named by us Cornice glacier, and referred to in *Ice-Bound Heights of the Mustagh*, p. 232, originates on the western declivity of the Biafo wall, thence falling rapidly to an altitude of 15,000 feet, and then still lower, as it descends in the deep gully to the west. From the

second, parallel wall mountain-spurs, enclosing the Sosbon and Hoh Lumba glaciers, run southward, while the main, south Hispar wall sends off others, which enclose the Alchori and other shorter tributaries of the Kero Lungma as far west as the Haigatum. It is a noteworthy fact that, while the northern face of the Hispar southern barrier runs for twenty-four miles in a straight line, unbroken by a single deep indentation, its southern face gives off spur after spur, enclosing important glaciers.

For a distance of fifteen miles above the tongue the whole of the Hispar surface is broken into ice-hillocks, separated by deep depressions, the latter, as well as a large proportion of the hillocks, being heavily coated with débris of every size, from mud and sand to granite-blocks twenty to thirty feet in diameter. Many of the hillocks have the form of symmetrical cones and pyramids, but many more show a perpendicular ice-face on one side, and on the other slant back to the glacier at an angle of 45° or less. This formation is more pronounced, and extends up the glacier to a greater distance, than the similar formation on the Chogo Lungma,

Face of peak, 22,060 feet, of south wall of Hispar above Hispar Pass. Note furrowed, avalanche-scored, corniced condition. Telephotograph from Upper Base Camp, distant about four miles.

which has a length of nine miles, or that on the Biafo, which only reaches a point about three miles above the end of the tongue.

A short distance below the entrance of the Haigatum branch, a narrow band of smooth, white ice appears among the débris-covered hillocks, which becomes broader as one ascends. This is the last remnant of the white ice, which presses down along the left or southern lateral half of the glacier. Its relation to the hillock-area will be mentioned later. On the north half of the glacier the hillocks persist for eleven and a half miles farther to the entrance of the Kanibasar branch. Above the Haigatum many of them are oblong in shape and are arranged in lines, but below the Haigatum such arrangement is less apparent. They vary in height from 50 to 230 feet, but some, as will later be stated in the discussion of their causation, exceed the latter height.

From the edge of the hillock-area to the ice-falls below the highest part of the glacier, the surface consists of fairly smooth, somewhat rolling, white ice, bearing only a moderate amount of débris. On the north side this section is only a few miles in

length, reaching from the Kanibasar glacier upward ; but on the south side it extends well downward towards the Haigatum branch.

The last and highest portion of the glacier forms the Hispar Pass. As already described, this is a plateau something over three miles long and about the same in width, covered with driven snow, unbroken by crevasses, and gently rising to a snow-ridge crossing its eastern end from north to south, which terminates in an ice-shoulder descending from the last snow-peak on the wall. The height of this ridge where crossed, just at the extreme line of avalanche-action, was found to be 17,500 feet. The descent from the ridge on the Biafo side is considerably sharper than the ascent to it from the Hispar Pass.

North of the pass, and east of Last Moraine glacier, lies the large, snow-clad region behind Biafo Hispar Watershed Peak and its *contreforts*, the average level of which at its upper part is some 2500 feet above the pass. This sends down to the Hispar its highest northern branch, the large snow and névé-covered glacier explored by us with Rey, and named Névé branch. This is one of the largest

Four hillocks of the larger variety, completely covered with rock-débris, standing in line in centre of Hispar glacier, eighteen miles above its tongue.

contributors to the Hispar stream, and the snow and ice from it break down into the latter in a chain of tumultuous ice-falls.

The reservoir of a glacier consists of a basin or basins, usually enclosed by mountains, and the highest portion of its own structure, which collect the snow that contributes to its formation. The dissipator is the lower portion, of varying extent, where melting exceeds the ice and snow-supply, and where, therefore, the glacier wastes away. The Hispar reservoir comprises the greater part of the region just mentioned, the whole of the Hispar Pass to the highest, summit-snow-arête, and the whole northern slope of the southern Hispar mountain-barrier, for a distance downward of twenty-one miles to the opening of the Haigatum branch.

The powerful pressure from the north exercised by Névé branch, aided by that of Last Moraine and the large Kanibasar and Jutmaru branches, forces the glacier over bodily hard against its southern wall, which pours down a constant succession of glaciers, ice-falls, and avalanches, over the line of contact, covering it so completely that the glacial surface, sloping upward into that of the wall, forms

as intimate a connection with it as does that of any glacier with that of its initial reservoir. At no point in this long distance can any interval be seen between the edge of the glacier and the wall.

A remarkable circumstance connected with this is, that for fourteen miles above the Haigatum branch, the main part of the glacier opposite the ice-wall, excluding a comparatively narrow section adjoining the wall, serves as a dissipator, all loose snow—and, indeed, over much of it, all névé—being melted away in late summer. Also the northern edge of the glacier throughout this section, in complete contrast with the southern edge, has so melted away that it lies at a considerable distance from the mountain-slopes, which themselves at that season are free from snow.

A peculiar feature of the Hispar, not observed on the Biafo or Chogo Lungma, is the great number of lakelets scattered over its surface, especially in the hillock-area. From almost any point a dozen or twenty in the immediate vicinity may be counted. With their transparent water of beautiful green, or reflecting the deep blue of the sky, they flash in the sunlight like emeralds and sapphires from their

Lake in centre of Hispar glacier in region of ice-hillocks, extending on left beneath one of them.

Portion of lake in centre of Hispar occupying depression between hillocks. Note circles on surface caused by falling stone

setting of brown and grey. The great majority of them are merely collections, or pools, of water, occupying the depressions between the hillocks; but some of the larger are highly picturesque, their cleft, scarred, and banded ice-barriers, in places thickly covered with rock-débris, enclosing beautifully curved bays, between which graceful crystal promontories project, and their surfaces dotted with islets of ice or partially submerged boulders. These lakelets exist even in the névé-area at an altitude of over 16,000 feet, corresponding here to similar lakelets found by us at about the same altitude on Basin glacier, the highest, northern branch of the Chogo Lungma, and described in *Ice-Bound Heights of the Mustagh*, pp. 285-286. These lakes are mostly formed by the settling of surface-water into the depressions. Very few of those observed were fed by streams even of small size, and few had outlets. There was a notable absence on the glacier of streams of running water, the greater part of the surface-water apparently finding its way into the lakelets. Few large streams such as exist on the Biafo were seen.

Besides these surface-lakes, many border-lakes

and a few sub-glacial ones were found at the lateral edges of the Hispar and its branches, resulting from the damming of water by ice or moraine-barriers. Some of these, their surfaces flecked with miniature icebergs interspersed among projecting boulders, in their setting of mountain and glacier, formed pictures of great beauty.

The existence over the greater part of the glacier of such a large number of surface-lakes implies an absence of crevasses, or, at least, the presence of very few; for, did any considerable number exist, the lakes either would not form at all, or would be quickly emptied. This inference was shown by observation to be correct in fact. Notwithstanding the extreme irregularity of the surface, few crevasses of any size were seen in the lakelet-area.

Crevasses are usually caused by steepness or irregularity of the glacier-bed, and are intimately associated with ice-falls. Only one series of ice-falls occurs on the Hispar, viz. in the section near its head, where it descends sharply from the Hispar Pass to the level of Last Moraine glacier, into which section the northern portion of its reservoir tumbles, also in ice-falls. Here large crevasses occur, though

Lakelets at upper part of Hispar at altitude of over 16,000 feet. Glacier surface covered with parallel ridges coinciding in direction with direction of slopes. Portion of caravan ascending glacier above.

Border-lake between east edge of Jutmaru glacier and lateral moraine. Note ice-floes dotting surface, and high, perpendicular, stratified, and blackened side of glacier. Mountains behind enclose heads of glacier.

many of them are neither long nor deep. From Last Moraine glacier to its tongue, the Hispar descends in an even, regular stream with a gentle gradient. In the twelve and seven-tenths miles from the upper edge of the Kanibasar junction to the lower edge of the Haigatum junction it falls about a thousand feet, or one foot in sixty-seven. This, together with the absence of crevasses, points to the conclusion that the glacial bed is practically smooth.

Now, in the case of a simple glacier without affluents, with a smooth bed of uniform breadth and gentle gradient, we should expect to find its surface smooth, even if bearing moraine. How, then, does it happen that the surface of the Hispar, where both the last two conditions obtain, is so universally broken up over the detritus-covered portions into high hillocks separated by deep depressions ? The answer to this question can only, it seems to us, be found in the effect on the glacier of its branches.

The four moraine-bearing branches on the north side above the Haigatum, coming from high mountains, exert a tremendous pressure on the main

stream, forcing it over bodily, as has been stated, against the ice-covered mountain-wall on the south side. Being prevented by the wall from yielding any more, and being compressed into the smallest possible space, the main stream resists further encroachment on the part of the branches.

Under such circumstances, what next happens depends on the resisting power of the ice to compression as compared with the pressure brought to bear upon it. If the former be greater than the latter, the branch simply turns in a curve into the space, from which it has pushed the main glacier, and moves downward side by side with the latter with a smooth surface, as is the case with the large Haramosh branch after its junction with the Chogo Lungma. If, however, as is the case here, the pressure is greater than the resisting power of the ice, the ice is obliged to yield still farther, which it does in the direction of least resistance, *i.e.* toward its free surface, and is folded up into ridges and protuberances having a size and height proportioned to the excess of pressure over resistance, till an equilibrium is established.

Owing to the conditions existing at the lines of

impact of the branches on the main stream, the direction of pressure varies at different points, and in consequence ice-hillocks, many of them of great size, are formed instead of long ridges. While some of these, as already stated, take the forms of symmetrical or oblong cones and pyramids, their contours probably rounded somewhat by the heat of sun and air, the shapes of others in the hillock-area indicate that, under the severity of the pressure, the ice composing them bursts asunder and faults, one portion being crowded high above the other as a perpendicular ice-cliff shelving back to the glacial surface on the farther side. This process occurs most markedly in the upper layers of the ice, the lower ones, so far as can be seen, remaining in or being crowded into solid contact without the development of crevasses.

The hillock-formation first appears at the line of junction of the Kanibasar branch with the main stream, developing in the Kanibasar area as it moves downward. At the entrance of the Jutmaru it becomes more accentuated, the pressure here being evidently increased, and the broken surface extends upward into the Jutmaru itself for nearly

two miles, while it also spreads out laterally farther over the Hispar, encroaching still more on the area occupied by the white ice. The pressure is augmented at the junction of each succeeding, lower, northern branch.

The entrance of the Haigatum and the five lower branches on the south side now introduces a new factor of active counter-pressure, thereby enormously increasing the compressing force to which the ice is subjected. The effect of this manifests itself immediately. The white ice, which after the junction of the Jutmaru branch narrows rapidly, and, opposite the Haigatum, is reduced to a slender tongue, just below this point is completely overwhelmed and disappears from view. From here to the end of the Hispar, a distance of fifteen miles, only a chaos of detritus-covered hillocks is seen. These, which higher up were more or less arranged in lines, are here thrown into disorder by the variety of opposing forces. They are also crowded up to a greater height, and, opposite the Makoram branch, their apices attain a height of 279 feet above their bases.

It is worthy of note that, while the depressions

Surface of Jutmaru glacier, about a mile above junction with Hispar, broken by the tremendous pressure into detritus-covered hillocks similar to those of Hispar. Four members of party ascending hillock at right.

between the hillocks are heavily covered with detritus, the apices of many of the hillocks themselves are comparatively or wholly free from such covering. As the presence of detritus in quantity protects the ice beneath it from melting under the heat of air and sun, the exposed apices must melt much faster than the protected furrows between them, thus reducing, perhaps to a considerable extent, the original height to which the hillocks have been crowded up by pressure. The figures representing the heights of the hillocks, obtained by measurement of those observed, do not therefore indicate the full effect of pressure in determining the condition of the glacial surface.

The similar, though less pronounced, formation existing at the lower ends of the Chogo Lungma and Biafo glaciers appears only after the lateral pressure on their streams has been increased by the junction of large branches and narrowing of their beds. A reach of typical hillocks was found at the middle third of the Biafo, in the area of a large, western branch entering at that place, but it disappeared lower down. At and below the junction of the Alchori glacier with the Kero Lungma, the

former descending with a sharp gradient on the latter, a similar crowding up of the surface was observed by the authors in 1903, the elevations presenting some of the largest, highest, and most impressive, ice-slants we have anywhere seen on a glacier. The hillocks here were composed of ice bearing but little moraine-material.

A notable instance of this formation, exactly paralleling the Hispar hillocks, and by no means yielding the palm to them in size or height, as it was larger than any of those observed on the Hispar, was met with in the Nun Kun in 1906.[1] This was only a single hillock, but its genesis by pressure was all the more apparent on that account. It occurred at the line of impact on the Shafat glacier of a short branch falling some 9000 feet directly from two high peaks. It was covered thickly from bottom to top with black detritus, while the side of the Shafat, which was opposing its advance, was clothed with red granite detritus, so that the area occupied by each was clearly marked. This instance and the hillock-area of the Hispar were especially favourable to the study of this process, as it was

[1] Vide *Peaks and Glaciers of Nun Kun*, p. 44, illustration.

not complicated by the presence of ice-falls or séracs in either case.

The pressure of most of the branches at the line of their first contact with the Hispar acts on the latter in a direction nearly or quite perpendicular to its axis. As the branches, under the pressure from behind and the resistance of the main glacier in front, turn in great curves toward the west and align themselves with the main trunk, the pressure is transmitted around the curves so as to act finally at right angles with its former direction, or parallel with the glacial axis. Hence it follows that the lateral displacing power of the branches on the glacial trunk is greatest at or shortly below the line of their impact upon it, diminishing as the angle of contact in their passage around the curve becomes more acute, and becoming practically nil when they have fully aligned themselves with the glacial axis, and become constituent columns of the main trunk.

An interesting circumstance connected with the pressure of the branches, especially of those above the Haigatum, which have no opposing branches on the south side, is, that when an equilibrium has

been established by the yielding of the main stream, the compression and folding of the ice, and the pushing up and faulting of its upper layers into irregular projections, and the branch has turned into and occupied the space from which it has displaced the main glacier, the compound glacier thus formed moves downward until joined by the next lower branch, without exercising any perceptible return lateral pressure toward the side from which the branch enters. This is seen in the fact that, after the branches have turned downward in the direction of the glacial axis, their free edges, though broken and greatly serrated, rising perpendicularly high above their beds, run in straight lines at considerable distances from the former lateral moraines or from adjoining mountain-walls to the junction of the next lower branch. The same was observed to as marked a degree on the Biafo.

A noticeable peculiarity of the Hispar, particularly for a glacier carrying such a vast amount of detritus, is the paucity of median moraines on its surface. Throughout the hillock-area, heavily coated with débris, which in many places conceals the ice completely from view, where median moraines

West bank Haigatum glacier at Camp Haigatum, composed of five moraines rising one above another. At right, black edge of glacier. Beneath it and between it and ragged moraine adjoining was a subglacial lake. Two larger tents at left stand on top of third moraine from glacier. Two smaller tents beyond stand on fourth moraine. Above them part of fifth is seen. In background Jutmaru glacier enters, pouring its mass of hillocks far into Hispar and narrowing white ice to mere ribbon.

might be expected to exist, no well-marked ones are observable. This is, apparently, due to the continuity of the abundant moraine-material being destroyed by the broken, irregular condition of the surface. Aside from this area, such moraines are rather feebly marked over the remainder of the glacier. A few small ones extend out from the south ice-wall just above the entrance of the Haigatum, and one also on the north side from Last Moraine glacier, and a good-sized one for a short distance from the Kanibasar, but otherwise the remarkable, highly developed moraine-formation existing on the Chogo Lungma and, to a less extent, on the Biafo is wanting. Large median moraines exist on the larger branches.

Not so, however, with lateral moraines. On the south bank of the glacier below the Haigatum, and along the whole of the north bank as high up as Last Moraine branch, gigantic, ancient, primary moraines, overgrown with dwarf-willows and other vegetation, exist. The highest of these are found on the north bank between the Lak glacier and the end of the Hispar, where the ridges of some of them, as measured by Drs. Calciati and Koncza,

stand 394 feet above the present surface of the ice. Between these and the glacier more recent secondary moraines, some of them of large size, are seen at various places. On the west bank of the Haigatum, just above its entrance into the Hispar, five lateral moraines were found, one below another; the fifth, by no means a small one, being still in process of formation. The highest, recently formed, lateral moraine adjoining the ice is situated on the north side of the Hispar, just below the junction of the Lak glacier. Its height was measured at 131 feet.

The Hispar and its larger branches, and also the Biafo at certain points, are at present actively engaged in building lateral moraines. At the edges of these glaciers great, ragged, perpendicular ice-walls rise high above the glacier-bed, their summits as well as their substance heavily loaded with débris, which is constantly showered down, often in cart-loads, upon the moraines at their bases. At some points the moraines can be seen to grow day by day, and even hour by hour. As these walls move downward in straight lines, they, apparently, exert no lateral pressure on their lateral moraines, so that

Side of Jutmaru glacier, about two miles above its junction with Hispar. While we were passing, three mud-and-rock avalanches slid down to lateral moraine below at right. Their paths seen on side of glacier. Two rocks falling down central path.

Edge of Haigatum glacier opposite Haigatum Camp, showing débris on its surface and within its structure. Intraglacial moraine at left formed by the filling of large crevasse with débris. Note twisted stratification of ice.

there can be no question as to their forming moraines by pushing or ploughing up ground-moraine material. There was also no evidence that such material was pressed out on their sides by their weight. The moraines appeared to be wholly built up by the deposition of the débris borne on the glacial surface as well as in the crevasses and substance of the ice-walls.

Some fine examples of intraglacial moraines cropped out in places on the glacier-edges, composed of detritus which had fallen into and filled large crevasses. The capacity of the Hispar as a moraine-builder appeared to be exhausted before its ice reached the extremity of its tongue. In contrast to the large lateral moraines the terminal moraine-formation was not marked, only a small moraine existing in front of one section of the tongue.

Névé and glacier-ice are composed of strata, or bands, which represent the snow-accumulation of successive seasons in the reservoir. At the sources of a glacier these are of considerable thickness, and overlie one another in horizontal or gently curving layers corresponding with the conformation of the terrain on which they rest. In a glacial trunk they are

compressed, often into thin ribbons, and their edges may be tilted to any angle with the horizontal. They may also be curled and twisted into serpentine folds.

A great glacier is not the best place to study the relation of banding in the trunk to névé-stratification in the reservoir. In the complexity of currents, the breaking-up into ice-falls and séracs, the displacements, the regelation, the conditions of pressure, folding, and torsion, and other accidents to which the ice of such a glacier is subjected, the difficulty of tracing the relation of the final structure of a given mass of ice to that of the névé in which it originated, after the great distance it may have travelled from the place of its origin to that where it is observed, is obvious. Indeed, it is marvellous that, considering the vicissitudes it has undergone, the ice near the tongue of a thirty-mile-long glacier should retain such perfect stratification as it often exhibits. This subject is more advantageously studied in short, uncomplicated glaciers.

On all broken surfaces of the Hispar reservoir, and among the ice-falls just below, névé-stratification was well marked, the strata being horizontal or somewhat curved. So on exposed ice-surfaces at

A large mass of ice on edge of Jutmaru glacier partly submerged in a border-lake. Note twisted strata of mass, the great amount of rock-débris on its surface and in its structure, which, as freed by melting, was falling into lake at short intervals, and ice-floes floating in water.

all points of the glacier, even to the extremity of its tongue, stratification was visible; but the strata ran in every direction according to the conditions to which the ice had been subjected in its downward journey. Perpendicular strata were common. They were, in many instances, curled and twisted into curious patterns, while in one large ice-ledge projecting from the extremity of the tongue they were as horizontal as could be found in level névé. Over the greater part of the end of the tongue they could not be observed, owing to the discoloured and detritus-covered condition of the ice.

Not one of the grassy, flower-sprinkled maidans, described in connection with the Chogo Lungma and Alchori glaciers in *Ice-Bound Heights of the Mustagh*, pp. 179, 352, 361, was met with on the Hispar. The mountains rise too abruptly from the glacier to afford any space for these. One such maidan was found at the junction of a branch of the Jutmaru with that glacier, and utilised for a camp. This was of alluvial formation, and had recently been the bed of a border-lake, which had mostly silted up through the deposit of mud poured into it from streams from a glacier above.

CHAPTER XII

Claims regarding Altitude of Mount Huascaran—Mrs. Bullock Workman sends Expedition to triangulate its two Summits—Details of Work —Results.

LET us now for a moment turn from the consideration of the Karakoram region to that of a question affecting a mountain on the opposite side of the earth—in the Andes.

After returning from her expedition to Mount Huascaran in Peru in 1890, Miss A. Peck claimed to have attained a very high altitude in climbing the lower of the two summits of that mountain, the altitude being differently stated on different occasions, but finally being placed at, certainly, 'above 23,000 feet,' and, probably, '24,000.' As a corollary of this Huascaran, contrary to the generally accepted opinion of geographers, was asserted to be 'higher than Aconcagua,' and therefore 'the loftiest mountain known' in the Western hemisphere.

These contentions being based, confessedly, on

eye-estimates only, and not on any facts previously known or newly discovered, or on any measurement-data whatever, were naturally regarded with incredulity by geographers, engineers, and mountaineers. Expression of dissent appeared here and there on the part of those who chose to take notice of them, but the material available to refute them was very slight, no measurements of this mountain having been made, with the exception of a single triangulation of its higher summit many years ago, of the details of which little appears to be known.[1] The result of this triangulation gives the altitude of the higher of the two summits as some 2000 feet less than that assigned by Miss Peck to the lower summit claimed to have been ascended by her.

Matters standing thus, and there being no immediate prospect that any satisfactory solution of the questions raised would offer itself, in the interest of mountaineering science, which, among other things, demands that, as a matter of fairplay to others, no claims should be made for altitude

[1] Raimondi in his classic work on Peru in 1876 mentions the engineer Kindl in connection with the triangulation of Huascaran, whose observations were, apparently, made in the course of the survey for the railway in the valley of Huaraz. The altitude of 6721 metres (22,044 feet) since given to the peak would appear to be the result of Kindl's measurement.

attained that has not been determined by a recognised method of measurement, as well as to ascertain the actual facts, since the claims made with regard to Huascaran affected her own position as the heretofore undisputed holder of the altitude-record for women, won by strenuous effort on mountains presenting technical difficulties of the very first order, Mrs. Bullock Workman, in June 1909, decided to send an expedition composed of expert European engineers to Peru, to make a thorough and accurate triangulation of the two summits of Huascaran, which would be recognised as authoritative, and as definitely settling the questions involved.

Through the assistance of Messrs. Fr. Schrader and Henri Vallot, acting for the Société Générale d'Études et de Travaux Topographiques of Paris, an expedition was sent to Peru for Mrs. Bullock Workman, under the direction of M. de Larminat, to effect this purpose.

Assisted by the Peruvian Government and favourable weather, M. de Larminat and his assistants were able to carry out this work successfully between August and November 1909.

A base, 1600 metres (5248 feet) long, was measured

in the Rio Santa valley in the Black Cordillera at an altitude of 3800 metres (12,464 feet). This base was measured by means of a 50 metre (164 feet) tape of invar metal. From two stations, one at either end of this base, and from two others, the positions and altitudes of which were determined by trigonometrical measurements from them—that is, from four stations in all—the positions and relative altitudes of the two summits of Huascaran were fixed by azimuthal and zenithal angles taken by theodolite.

In order to ascertain the true height of these stations above average sea-level, a progressive levelling was conducted from the highest station, called the Garganta Signal, down along the mule-path leading from Yungay by way of Quillo to the sea at the port of Casma.

The Garganta Signal is higher than the col where the path between Yungay and Casma reaches its highest point. The difference in height between these two was ascertained by triangulation from the Garganta Signal to be 159 metres (521½ feet). From the col down to sea-level at the port of Casma the levelling was performed by means of the tacheo-

meter. The altitude of the Garganta Signal being thus established, it was an easy matter to fix the altitude of the other three stations, from which the triangulation of the summits was made, as well as from the Garganta Signal.

From two of these stations from which it was visible, the altitude of the church tower at Yungay was also established at 2568 metres (8432 feet).

The average sea-level was determined by four double observations of two water-marks, made at intervals of six hours ten minutes between each. The agreement of these was satisfactory owing to the small amplitude of the tide at Casma, and also to the fortunate circumstance that the observations were made at the time of neap-tide.

The results of these measurements show the height of the north summit of Huascaran to be 6650 metres (21,812 feet), and that of the south summit 6763 metres (22,182 feet). The observations and details of the calculations made from them have been carefully gone over, and verified by M. Henri Vallot, who testifies to their accuracy. A full report by M. de Larminat of his work, with maps and diagrams, has, with the permission of Mrs. Bullock Workman,

been presented to the Peruvian Government, and published in French for presentation to scientific societies.[1]

The above measurements, scientifically and carefully carried out, establish beyond cavil the altitude of both summits of Mount Huascaran. They sustain the universally accepted opinion that Aconcagua, whether its height be considered 6593 metres (22,805 feet), as triangulated by Schrader, or 23,080 feet, as triangulated by Fitzgerald, is the highest summit of the Andes. And they show that the altitude of the lower summit of Huascaran, claimed to have been ascended by Miss Peck, is some 1500 feet lower than the highest altitude attained by Mrs. Bullock Workman.

[1] Détermination de l'altitude du Mont Huascaran exécutée en 1909, sur la demande de Madame F. Bullock Workman, par la Société Générale d'Études et de Travaux Topographiques.—*Compte Rendu de la Mission.*

THE BASIN OF THE HISPAR GLACIER

BY

Dr. CESARE CALCIATI

AND

Dr. MATHIAS KONCZA

APPENDIX I

THE BASIN OF THE HISPAR GLACIER

Criticism of Existing Maps.—The whole basin of the Hispar Glacier is included in sheet No. 2 S.E. of the Topographical Map published by the Trigonometrical Survey of India (= 1 inch to 4 miles) with the following indications : Northern Trans-Frontier, parts of Hunza, Nagar (Kanjut), Sarikal, and Afghanistan.—July 1904. As regards the topography of the Hispar district this map is completely valueless, which is not surprising, considering the remoteness of the point and the exceptional difficulty of surveying-operations in those inner Himalayan ranges.

That map indicates two summits on the northern limit of the Hispar basin, which boldly stand between this and that of the unexplored region lying to the north. The map and private information from the Trigonometrical Survey of India state the following :—

(1) A western peak, lat. 36° 12′ 45″ × long. 75° 13′ 79″, position fixed by means of two triangles, should be 24,500 feet high ; altitude determined by one ray.

(2) An eastern peak, lat. 36° 12′ 20·9″ × long. 75° 27′ 30·6″, position fixed by two good triangles, should be 25,492 feet high ; altitude determined by two rays. (Private information states 25,460 feet.)

The latter's name is said to be 'Kunjut Peak,' but it is entirely unknown locally. Now, crossing and re-crossing the glacier in all directions, we were quite unable to make out these two peaks amongst the others. Dr. and Mrs. Bullock Workman, who climbed one of the summits at the head of the Haigatum Glacier on the opposite side, could no more identify them.[1] It must be added that it is sometimes extremely difficult, from the glacier, to accurately grasp the course of the divides between the several basins. But, on the whole, we wonder if the representation of the several summits of the region, as stated on the map, is not the result of a misconstruction, especially as regards that part with which we are more particularly concerned, and which is shown in our new map at the scale of 1 : 100,000. It is quite possible, however, that the outstanding peaks can only be distinguished, from some remote point, towering above the whole region. In that case such a point should be indicated.

In 1892 Sir Martin Conway,[2] arriving by way of Nagar, went rapidly over this district and worked out a map on the one inch to two miles scale, including the basin of the Hispar Glacier. His map gives a fairly good idea of the country in the immediate vicinity of his itinerary. But, obviously, it was impossible for him to state cartographically the parts he had not seen. In consequence his representation of the tributaries of that immense glacier is devoid of all objective reality. How did Sir M. Conway succeed in identifying the two highest peaks above

[1] *Vide* discussion of this subject, pp. 78-80, 119-123.

[2] M. Conway, *Climbing and Exploration in the Karakoram Himalayas.* London, 1896.

mentioned ? According to him their positions with reference to the glacier are the same as stated in the Trigonometrical Survey of India Map.[1]

GLACIER ON THE ROUTE TO HISPAR OMITTED ON SIR MARTIN CONWAY'S MAP.

In one of his articles M. Ch. Rabot [2] gives a brief account of the work pursued in the Himalayan region, and draws

[1] It should be known that the Conway Map omits a small but very characteristic glacier which is clearly seen from the path along the southern slope of the valley, between the Barpu Glacier and the villages of Huru-Harrar, one day's march from Hispar. From the north-east that glacier opens south on the Hispar river, and fills the bottom of a magnificent V-shaped valley. Obviously Sir Martin did not see it, since he went to the left, coming from the upper part of the Barpu Glacier. The Trigonometrical Survey of India Map does not mention it either.

[2] Ch. Rabot, 'Études et Explorations en Himalaya,' in *La Géographie*, 15th February 1908.

interesting general conclusions. But he particularly insists on the twelve glacial tongues studied in 1906 by the officers of the Geological Survey of India.[1] Among these tongues we are specially concerned with two, namely, those of the Yengutsa and the Hispar.

The Yengutsa Glacier is a tributary of the Hispar river which opens close by the Hispar village. In 1892, at the time of Sir M. Conway's exploration, it must have occupied the upper portion of its valley at a distance of $3\frac{1}{2}$ kilometres from the Hispar river. (The name Rung-Pa given by Sir M. Conway was no longer used by the natives at the time of Mr. Hayden's and our own passage.) It is now only 900 metres distant, and this rapid progress was all made from 1892 to 1901, according to the natives. Since 1901 the glacier has remained stationary. During its expansion it has invaded a few morainic pastures on its borders and buried several small mills, thereby causing great damage to the inhabitants of Hispar.

Hispar Village.—It is precisely on the alluvial fan formed by the torrent at the mouth of the Yengutsa that the natives of Hispar find their subsistence. The melting of the glacier insures water throughout the whole summer for the irrigation of their meagre cultures. The natives have taken advantage of this permanent water-supply by digging small ditches kept up at the expense of the Mir of Nagar.

The fields have irregular shapes, and their gradient is the general gradient of the cone, but softened by a system of terraces and stone-walls.

The village, with its score of houses, is situated at an

[1] *Preliminary Survey of certain Glaciers in the North-West Himalayas*, etc.

altitude of 3280 metres. Wheat is the chief culture. As live stock they have the yak (*Poeplagus grunniens*), a black-and-white cross between the yak and the Indian zebu (*Bos Indicus*), and herds of goats and sheep. The half-wild yak lives a large part of the year on the moraine-pastures of the Hispar Glacier. The village of Hispar is placed between the two glaciers at 230 metres from the front of the Yengutsa and 2000 metres in a straight line from the tongue of the Hispar.

In June 1908 one of our party, Dr. C. Calciati, made a survey at the scale of 1 : 20,000 with the *règle à éclimètre*, of the portion including the tongues of the two glaciers, and thus carried further on the interesting tacheometer survey begun in 1906 by Mr. Hayden of the Geological Survey of India.[1]

As points of reference for the Yengutsa we adopted the same two beacons or stone-pyramids marked in black 'G.S.I.,' adding in red the initials and date of the expedition B.W. VI.1908.

After examining the observations and splendid photographs of Mr. Hayden, we may state that the Yengutsa Glacier has retained its characters since 1906, showing only a slight decrease in thickness and length. However, the withdrawal of the end-wall was only of some 30 metres as measured—not with the chain, but carefully—from the line of the pyramids on either side of the cañon. This figure refers only to the end of August, at the time of our departure. It looks very small, and, considering the activity of a glacial mechanism formerly so sensitive, we are inclined to see in it only the summer contraction.

[1] C. Calciati, 'Langues des glaciers Hispar et Yengutsa,' *La Géographie*, 15th October 1910.

We found also two beacons of the Trigonometrical Survey of India set up for the Hispar Glacier on both sides of the stream. The one on the right-hand bank could only be seen with difficulty on the grey background of the moraine. We had to replace it by a huge, erratic granite-boulder, on which we wrote in large red letters $\frac{\text{B.W.}}{25.\text{VI.}1908}$. The same initials with the date—23.VI.08—were written on an out-

EXTREMITY OF THE HISPAR TONGUE FROM THE ROCK MARKED 23.VI.08.

crop of polished rock close by the pyramid on the left bank by the side of the path to the glacier. The remarks made for the end-wall of the Yengutsa hold good for the Hispar, but in the case of the latter the contraction did not exceed 10 metres.

By the end of August, however, the thickness of the tongue was materially reduced, and big blocks of ice having tumbled down had been partly carried away by the sub-glacial stream. A line drawn between the pyramid on the left and the erratic boulder, above mentioned, passes precisely by the front of the ice-tongue.

The Hispar Glacier, at least since 1892, appears to have remained stationary. Yet explorers in these regions record an increase of aerial precipitation similar to that observed in the Alps during the same period.[1] The Hispar on account of its colossal mass and length has not felt the effect of this. On the other hand, the Yengutsa and many other transverse glaciers of, relatively, very small length have felt, from the névé down to their points, the effect of an increased supply. Should the Yengutsa still advance a few hundred metres it would dam the Hispar stream and produce, perhaps, a veritable catastrophe. A number of similar instances taken in this region tend to demonstrate how its cycle of erosion is yet at its primitive, or young stage. It is only along this line of thought that the general character of all the valleys of the Himalayan region can be explained.

Arriving at Hispar on the 2nd June, we approximately realised the extent of the basin of the Hispar Glacier, and all at once the question arose, how to plan our work so as to succeed in producing a general map of the glacier and its tributaries. We knew that the extremely limited time at our disposal, viz. three months, would yet be shortened by bad weather. A few clouds round the summits would be quite enough to stop the work of triangulation. It was,

[1] Cf. Ch. Rabot, *op. cit.*

therefore, imperative to push ahead with all our might and take advantage of every clear day. We divided the labour: one was in charge of the *règle à éclimètre*, the other of the theodolite.

Our Map.—The map on the 1 : 100,000 scale, which is appended, is based, especially for the whole of its altimetric points, on a triangulation carried out with the theodolite by Dr. Mathias Koncza. The vicinity of Hispar village and the main tributaries were surveyed by Dr. Calciati with the *règle à éclimètre* of the Goulier type.[1] In addition a large number of stereoscopic and panoramic views, along with many panoramic sketches with the camera lucida and detailed notes, were taken on the spot, and were a great help in drawing the map and reminding us of the topographical peculiarities of the region under consideration.

We first thought of basing our work on the points supplied by the Trigonometrical Survey of India, either by adopting the altitude stated for the village of Hispar, viz. 9970 feet, or by connecting with the two summits already mentioned which we had hoped to identify from the glacier. We did not give effect to that, however, for two reasons :—

(1) From information supplied by the Trigonometrical Survey of India itself, the altitude of Hispar is doubtful, and we did not know what point of the village had been referred to.

(2) It was found impossible, as already stated, to identify the two summits indicated by the Trigonometrical Survey of India.

[1] Adopted in the French Army Topographical Service.

A. *The Base.*—We, therefore, started in the south-west corner, from the highest house of Hispar found at 3280 metres elevation. This had been carefully measured with the hypsometer and the aneroid, adopting the average of our observations.[1] For this calculation we referred to readings at the Government base-station at Gilgit where, from June 25th to August 31st, three barometric and thermometric daily observations were taken regularly.

From point 3280 of Hispar, which is easily recognised by its red mark, we measured several times with the *règle à éclimètre* a distance of 326 metres in the north-east direction, and at the other end we built a pyramid 1·50 metres high, marked at the base $\frac{\text{B.W.}}{\text{S.VI.1908}}$ and painted red at the top. The nature of the ground did not permit of a longer base being profitably taken. On this altimetric [2] and topographic base at Hispar the whole of our cartographical operations were founded.

Our main object was to study and express the interesting phenomena and the geographical features of this, as yet, little-known region. When a first-rate triangulation of the Trigonometrical Survey of India shall have succeeded in accurately fixing the position of the main points of the Hispar Glacier, our map will thus be correctly placed.

B. *The Triangulation.*—Dr. Koncza's first notion was, of course, to follow the general principles and practice necessary for a good triangulation of the first order. First

[1] Dr. and Mrs. Bullock Workman found 3282 metres. We found 3278 metres at a month's interval. We, therefore, took the average of 3280 metres for the highest house of Hispar.

[2] The altimetric calculations were made from our hypsometric and barometric data by the 'Bureau Central Météorologique Suisse de Zurich.'

he had to correctly grasp the general nature of the district in a general view from some dominant point. Thence he was to draw a preliminary schematic plan and choose two other stations. These three points were to form the apices of a base-triangle, and from them by radiating sights it was possible to determine the other points. On the whole, in triangulation work, the best result is obtained by the simplest network and isosceles triangles.

In this particular case it was necessary to go up to the highest pass between the Hispar and the Biafo, which point, it was surmised, dominated the whole country. There, obviously, was the apex of the first triangle of reference, the base of which was, naturally, to be a transverse line across the glacier, down the valley and between two peaks chosen on either side. From these two points, then, it was possible to work back to the two summits of the Trigonometrical Survey of India and see not only all the important trigonometric points of the Hispar basin, but some of the surrounding peaks. From Hispar village one can only see a portion of the glacier, because its bulging prevents one forming a complete idea of it.

Provided with a month's food-supply, Dr. Koncza started on the 5th of June and arrived the same day at ' Bittermal,' the first point on the lateral moraine north of the Hispar Glacier. There he was overtaken by snow and bad weather. The coolies refused to go on. On the other hand, the upper portion of the glacier was still covered with snow, and to reach the pass was a matter of great difficulty.

During the lulls he carried on trigonometric operations round Bittermal, Gandeshish, Shenishshish, and Makorum, and built beacons at each station. On the 11th he crossed

the glacier to go to Makorum, reaching as far as the vicinity of Haigatum. All the while he was endeavouring to give effect to his theoretical plan of triangulation. Soon, however, he satisfied himself that the nature of the ground precluded that possibility. The Hispar Glacier forms, indeed, too long a valley, and is shut in by peaks some 7000 metres high, none of which are accessible. Moreover, the branches of the glacier are fed by vast névés, which communicate with the main trunk by means of gorges so narrow as to forbid all distant sight from below.

The weather being hopeless Dr. Koncza returned to Hispar village on the 13th. Meanwhile he had devised another plan of campaign, working from below up-stream, and had to give up taking full advantage of the theodolite. It therefore became necessary to obtain a good base on which to ground the general map, which was to be one of the results of the expedition.

Dr. Koncza worked from the 326-metre base at Hispar, and, by means of a system of pyramids, established at the tongue of the glacier another base measuring 2323 metres, whence, with the help of other pyramids, he worked up to the pass, building, as it were, a trigonometric chain and carefully sighting all important points with a view to the map. That work, usually so easy, turned out to be a long and painful process. For, whenever a point was to be got on a moraine up-stream, he had first to go and erect a pyramid and return to the lower station in order to take the connecting reading. This involved an enormous loss of time, as these stations were often two to four hours distant. On one occasion, with the view of avoiding a delay that might have proved fatal to us, Dr. Koncza sighted an enor-

mous, erratic boulder which distinctly appeared as though lying on the left moraine of a small tributary. Once on the spot, however, he discovered the boulder embedded right in the live glacier. Consequently there was a rambling trigonometric point ! It stood near Camp VII. This point, however, had no real importance. We only mention it here to illustrate the difficulties attending triangulation-work in these districts.

The working-plan selected as best fitting the particular conditions of that region offers the following drawbacks :—

(1) This traverse system always in the same direction was bound to emphasise and increase any possible mistakes without any correction.

(2) Too many stations and points—whether pyramids or natural features—rather increased the chances of errors.

(3) So narrow are the gorges of the tributaries that it was impossible to intersect a sufficient number of summits surrounding their feeding basins.

(4) High peaks seen from below readily change shape according to the point of observation.

(5) It was found impossible to take in the chief summits surrounding the Jutmaru and the Kanibasar Glaciers, as the cliff which forms the southern wall of the upper Hispar Glacier is encumbered with snow all the year round. A theodolite-station is out of question here.

(6) It was found impossible to identify the summits of the Trigonometrical Survey of India's triangulation.

West side of glacier. West Head. Upper end, main stream. East Head. East side of glacier.

Panorama of Jutmaru glacier, by Dr. Calciati, from point in centre of glacier midway between Hispar glacier and camp at upper end of main stream. *Vide* map.

(7) The far sights from below upwards necessarily involve an error of refraction since they traverse atmospheric layers of increasing thinness.

The possibility of confusing the points sighted was excluded by means of accurate sketches taken with the camera lucida.

As a result of this triangulation work, Dr. Koncza had to show—

26 stations with the theodolite.
429 direct readings.
116 double readings for verification, not including reciprocal angles.
76 summits exactly placed and checked by all calculations.
14 placed only graphically with the protractor.

Of the total number of points sighted, 40 were lost as they were not visible at the second station.

On the whole, the material result is important, and the number of points fixed quite satisfactory.

All the erratic boulders on the lateral moraines which served as trigonometric stations were marked by an isosceles triangle in red, the initials B. W. and the date of the expedition, the number, and a small k.

The Hispar Glacier.—From below there is only one point from which one may see at once the village and the pass to the Biafo. It is situated on the southern lateral moraine on the site of Gandeshish.

Assuming now that a fair image of the glacier can be formed from our map, we shall briefly survey its specific features.

To one accustomed to Alpine landscapes the extent of the Hispar will be a matter of surprise. Its maximum length is exactly 56·626 kilometres, while its average width is 3 kilometres. It is interesting to remember for the sake of comparison that the Aletsch, the largest of our Alpine glaciers, is only 16 kilometres, excluding the névé.

The Hispar valley is distinctly U-shaped, but somewhat open, not being shut in by sheer walls as is the general case with Himalayan glacier-valleys.

The system of terminal moraines does not display a regular morainic hemicycle. The valley, getting narrower, is, indeed, at once encumbered with lateral fans eroded by the Hispar stream. At a horizontal distance of about 1400 metres from the glacier, there exist, it is true, undoubted remnants of comparatively recent, terminal moraines, but the whole system is so eroded and mixed with torrential deposits as to form a shapeless mass.

On the contrary, the successive remains of the last glacial extensions are clearly marked in four tiers on the lower portion of a fan lying just at the foot of the northern slope. The upper portion of this system is eroded by the very tongue of the glacier. These marks are fairly clear around Camp II., and may be distinctly traced up-stream. Here is, on the whole, a system of three, large, parallel, lateral moraines indicating four successive stages of the glacier. These three moraines have an average elevation of 25 metres. Upwards they thin out and join together, forming with that which emerges from the Lak tributary just one enormous moraine. This stands some 120 metres above the present level of the glacier.

The longitudinal spaces between the moraines are, at

present, being filled with the sand deposited by the torrents of the small, hanging glaciers. It is interesting to note how these torrents, instead of diving at once under the main glacier, are deflected and follow the general trend of the valley for 2 or 3 kilometres. All along the right bank of the glacier a large moraine may be traced between the mouths

MORAINIC DEPRESSION NEAR BITTERMAL.
On left and in foreground the great moraine of the Hispar.
Lak tributary entering Hispar in the distance.

of the tributaries. It occupies the margin of a few hundred metres between the live ice and the slope of the valley. In places, especially at the junction of the tributaries, through a raising of the glacier-side of the moraine or the meeting of the minor with the main moraine, a continuous dam gives

rise to a small, morainic lake or to a marshy depression. This is a general feature of glacial topography, which is constantly exemplified on the Hispar and its main lower tributaries.

These natural conditions favour the development of summer-pastures, as seen in Bittermal, where herds of domestic yaks from Hispar are led to graze. The large, lateral moraine north of the Hispar is strongly eroded by the ice. One may even trace successive tiers corresponding to the glacial expansions—especially in thickness—which are marked so clearly near the tongue.

From a topographical standpoint, the southern side differs materially from the northern. The southern lateral moraine is almost completely eaten out by the glacier. Near its tongue it is only revealed by a small lump still hanging on the slope of the valley. Further up, near Makorum and Shenishshish, it becomes large enough to stand up and dam a few lakes on its outside margin on which some old hovels are also to be seen. The reason of this difference is obvious enough from a glance at the map. The northern tributaries, so overwhelmingly superior in size and number to the southern ones, effect a tremendous push on the glacier and crowd it over on its southern shore. The Makorum and Haigatum glaciers are the only ones that oppose that pressure.

The surface-moraine is generally plentiful, even on its tributaries, and spreads a thick layer over the surface of the ice. Its thickness varies with places, from less than one to several metres. Its decreasing amount may serve to divide the glacial surface into three portions.

The down-stream portion, from Makorum downwards,

West side of glacier. Head of glacier. Kunjut 1. East side of glacier.

Panorama of upper part of Kanibasar glacier, by Dr. Calciati, from upper extremity of his route, as seen on map.

consists of a sea of cones or pyramids of ice covered with detritus, of 15 to 20 metres average height, but rising up to 85 metres. This most curious aspect is due, doubtless, to the solar heat guided in its action by the irregular protection of the morainic cover. By such a combined influence may be explained both the general choppy appearance and the strange shape of the cones.

It is interesting to note that these cones, in their typical shape and abundance, are to be found only in the lower portion of the Hispar and of its Lak tributary, and, on the whole, where the morainic matter is the most plentiful.

Further up they gradually dwindle till the surface changes to a series of long ice-ridges which have nothing in common with 'nieve penitente.' The ridges are covered with detritus on one side, whilst on the other vertical walls of ice are laid bare by melting. Gradually these walls recede until the whole ridge is eaten away.

The two different aspects of the glacial surface just mentioned characterise, in our opinion, the way of thinning or flattening of the Hispar. The tops of the cones represent undoubtedly the remnants of the continuous glacial surface, and the shaping influence of the superficial moraine is unquestionably of the strongest.

The third general portion is represented above the mouth of the Haigatum. The glacier assumes here a comparatively flat and smooth surface, showing with increasing clearness the divisions between the different strands of longitudinal surface-moraines. Moreover, from the Haigatum, the Kanibasar, and from the long rock-wall of the southern slope originate broad strands of bare ice.

The predominant material of all the moraines consists of

white granite with small, black speckles. The abundant arenas arising from the decomposition of the same rock are mostly felspar and mica with some amphibole and calcite.

Now if, with the help of the photographs, one attempts to picture a clear image of the Hispar and all its details, especially in the lower portion, one may easily realise the difficulties of a somewhat prolonged march.

The only ' parabolic bands ' on the Hispar come from the Jutmaru and appear to be over 100 metres distant. We doubt, however, if the term ' parabolic bands ' exactly fits the case. We rather think it was only some of the surface-moraine arranged in a semicircle, owing to a slice of ice progressing more rapidly than its neighbours which are covered with a heavier coat of detritus.

We have wondered whether there was an important ground-moraine. To verify its existence and importance was, however, too difficult. We, therefore, leave these points at a stage of plausible assumption.

Along the gigantic rock-bluff that runs from the Haigatum over the pass to the Biafo, a magnificent ' rimaye ' with varied festoons is displayed towards the close of the summer.

It marks the border-line between the snow still clinging to the rock and that snow which is carried away by the glacier. The repeated snow-slides from the bluff serve materially to feed the glacier. During the whole of our stay we had occasion to see and hear numerous and important slides which, it may be interesting to note, occurred during the night as well as during the day.

On this glacier crevasses are practically absent. Only a very few are scattered in the upper portion near the shores. Before arriving at the pass, through two large steps is dis-

played what may be termed an intermediate form between a crevasse and a terrace, but in the compact snow.

Two distinct terraces separate the pass from the glacier proper. In the transition between the glacier and the first terrace there exist in the compact snow several series of small lakes in longitudinal rows, the biggest being the uppermost. Generally the water is drained from one to the other down to the last, which loses it by percolation.

GLACIER-LAKES NEAR HISPAR PASS, AS SEEN FROM THE FIRST TERRACE.

There exists undoubtedly here a shallow but vast depression across the general dip of the glacier. This depression drains the superficial water, which then is arranged in longitudinal troughs by the trend of the glacier. Whether

this is due to glacial over-carving and to an obstacle across the valley, is hard to say. We can only state the fact.

The pass is at an altitude of 5310 metres, but it is extremely difficult to precisely identify the highest point between the Hispar and the Biafo.[1] It is, in fact, a broad and stately, high plateau of snow extending several kilometres and gradually passing from one slope to the other.

The Biafo Glacier which drains in the opposite direction continues the Hispar in the other longitudinal valley. But it remains unseen from the pass owing to the north-eastern spur of the great rock-ridge. The total length of both glaciers would be about 106,625 metres—that being the longest Alpine ice-tract yet known.

It is an instance of gigantic proportions which might be considered, as it were, as a manifestation of glacial ' transfluence.' Anyhow, there is no break of continuity. The same névé feeds both glaciers at once.

From the pass eastward there is a vast snow-trough which belongs already to the Biafo. We had no occasion to study it, but doubt if it offers any special interest.

The whole of the valley of the Hispar Glacier viewed from the pass recalls strikingly the aspect of some Norwegian fjords, ice replacing the water. The extreme length as compared with its breadth and the numerous tributaries of a similar type complete the illusion.

We have not measured the average limit of snows in this district. From its interior position, however, we are inclined to estimate it at 5400 metres, the limit being 5000 metres in Nepal and 6000 in Thibet.

[1] *Vide* pp. 174-175, 213-214.

The vegetation crawls very high up on the lateral moraines of the glacier. Up to the last moraine we found grass growing in quantity. Behind the large moraines, near the mouth of the Lak and near Bittermal, one encounters a fair number of old conifers (Thuyas). Their trunk is very thick, always mutilated and crowned with a few gnarled branches, which

STUMP OF AN OLD THUYA WITH A LIVING OFFSHOOT, FOUND ON THE REMAINS OF A LATERAL MORAINE NEAR BITTERMAL.

show clearly the influence of a long period under snow. The natives use their wood for fuel.

A species of salix forms, near Gandeshish and Makorum, a dense brush hard to cross. On all lateral moraines are to be found grass and alpine plants, a small collection of which was presented by us to the cantonal Natural History

Museum of Freiburg (Switzerland). In places, even on the surface-moraine of the glacier, plants may be found, as for instance on the medial moraine of the Makorum near its mouth, and on the cone region.

Tributary Glaciers of the Hispar.—We mentioned above that the Hispar itself had been visited by one party of previous explorers. Nobody, however (not even the natives), had ever ventured up the branches before the Bullock Workman Expedition. It was, therefore, interesting to know something of their chief features. Dr. Calciati had undertaken to explore the most typical of them and to furnish rapid surveys with stereoscopic and panoramic photographs. His plan of work was as simple as it was effective. It was simply to get at the centre of their feeding-cirques, whence all the principal points might be sighted. Then he was to make a traverse with the *règle à éclimètre*, and from each apex of the triangles to sight all the useful points, connecting as far as possible with Dr. Koncza's triangulation.

Of course that method is not among the most accurate, especially when one comes to intersections determined by too narrow angles. It may give satisfactory results, however, in some cases.

The branches, or tributary glaciers of the Hispar, which were specially surveyed numbered six : the Lak, the Pumarikish, the small glacier near Camp VII., the Jutmaru, the Kanibasar and the Makorum. The Haigatum and the others are quite sufficiently visible from the main glacier, especially from the opposite side, to allow of a direct survey. Unfortunately it was found impossible to give a satisfactory map of the Lak and the Pumarikish owing to a barrier of

crevasses which forbade access to the only point whence the traverse was to be started.

The native coolies generally dread the remote parts of unknown glaciers, and, though they may be induced to follow in one's footsteps, prove quite helpless in critical passages. Each excursion took two or three days according to the

GENERAL VIEW OF HEAD OF THE LAK GLACIER FROM NEAR ITS JUNCTION WITH THE HISPAR. Latter is behind photographer.

importance of the glacier. Sometimes important peaks remained hidden in the clouds. Others were only visible from one point, and it was found impossible to fix them.

On the northern side the important glaciers are the Lak, the Pumarikish, the Jutmaru and the Kanibasar, and on the south the Haigatum and the Makorum.

All the above glaciers join the Hispar with a regular slope without the interference of a step or terrace. The Pumarikish alone is connected by a flight of terraces.

Their connecting gully is steep and narrow, considering their feeding-basin, which is made of high, steep walls. There is no practicable pass between any two of the different

HEAD OF LAK GLACIER WITH DIFFERENT ICE-BANDS.
The farthest pyramid. Note widening of cirque.

tributary basins, far less between the Hispar and the surrounding basins. In the previous expedition Mrs. Bullock Workman going up the Alchori Col at the head of the Alchori Glacier, discovered a gap or pass to the southern side of the Upper Hispar. Access to our glacier, however, was prevented by the sheer cliffs on this side.

The Lak Glacier is one of the most important, and the only

one that offers a typical development of the surface and lateral moraines. The space left between the moraine and the left side of the valley is much larger than on the right side, and exhibits the same filling in by waters as on the Hispar.

HEAD OF LAK GLACIER A LITTLE FARTHER EAST THAN IN PRECEDING ILLUSTRATION, COMPRISING PART OF SAME BACKGROUND. Surface also shows several ice-bands and is seamed by transverse crevasses.

Dr. Calciati built two pyramids on the right bank of the Lak Glacier. One is near Camp No. IIIa. on the top of the large, lateral moraine before coming to the first small tributary. The other is beyond the second opening. At the latter point the upper corner of the moraine stands 60 metres above the ice. There also a shallow depression

MORAINIC LAKE AND SECOND TRIBUTARY ON THE RIGHT OF LAK GLACIER.

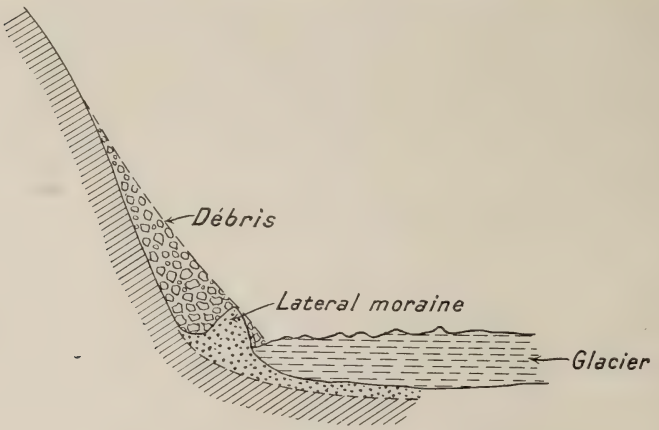


DIAGRAM OF CROSS SECTION OF LAK GLACIER,
SHOWING FILLING IN BY DÉBRIS.

is formed and occupied by a lake not less than 150 metres wide.

Between the two side-glaciers the space between the glacier and the side of the valley is filled by an enormous mass of débris which covers the moraine.

MORAINIC TROUGH NEAR CAMP IIIA. AND JUNCTION OF LAK WITH HISPAR.
As seen from the summit of Lak Moraine.

Not far beyond the small tributary near Camp IIIA. there is another morainic trough, which, however, cut down for itself a deep outlet through the morainic dam.

Close by Camp IIIA. itself the same feature is repeated on a larger scale.

The Pumarikish Glacier, though much smaller, has also

near its mouth two fair lateral moraines, the slopes of which are steeper than the others.

Two stone-beacons were built on the moraine and the right side. Above the farthest one Dr. Calciati climbed up to a point of 4799 metres elevation, as measured with the

THE PUMARIKISH GLACIER AND ITS RIGHT LATERAL MORAINE, LOOKING UP THE GLACIER. CAMP IV.

hypsometer and the aneroid, and from that point, situated on a small hanging tributary, it was easy to follow the course of the dividing ridges of that basin.

The surface-moraine of this glacier is scattered and shows the ice. The whole surface, especially the middle portions, is full of crevasses.

The Khatumburumbun or Utumburumbun Glacier is very thin and is made of two long upper branches. It discharges into the Hispar and over its morainic mass, by a splendid fall of séracs, along a steep gradient.

Obviously it has greatly shrunk, for its former lateral moraines are a long way from its actual ones.

HEAD OF PUMARIKISH GLACIER AS SEEN FROM POINT NEAR 4799 METRES STATION.

The Sekambaris has a strong gradient. It divides into two tongues, each of which gives rise to a stream. Its shrinkage is so great that it stops at present at 900 metres from the Hispar. The intervening space is a shallow trough, ploughed by meandering streams and showing clearly the recent presence of the glacier.

The former front moraine exists and joins the lateral one of the Hispar.

The feeding basin of the Jutmaru is unquestionably the largest of all. Its surface is striped with longitudinal morainic ridges, 20 to 30 metres high, between which the bare and furrowed ice shows, recalling broad, white roads.

SURFACE OF PUMARIKISH GLACIER WITH TRANSVERSE CREVASSES.

The small glacier of Camp VII. exhibits a curious feeding-trait. A real ice-fall arising from a hanging side-névé tumbles down a shelf into the glacier itself.

Farther up-stream we cannot say how matters stand. Beyond the highest point reached the ice was fissured, and on the 27th July the glacier was still hidden under snow.

The divide with the Kanibasar canyon is very narrow and serrated. Its lowest point stands about 90 metres above the glacier. Constant rock-slides down the gully prevent access to it.

On the whole, the remarks made about the Jutmaru hold good for the Kanibasar.

KHATUMBURUMBUN GLACIER FROM A POINT ON THE HISPAR MORAINE ABOVE, OR ON ITS EAST SIDE, LOOKING WEST.

The gully of the latter exhibits fewer morainic ridges and more ice. Its head is much more encumbered with snow on account of the altitude.

In both valleys superficial water circulation is strongly marked in impassable and rapid torrents.

Coming to the two main tributaries on the southern side of the Hispar, in both cases surface-moraine was found abundantly and lateral moraines were displayed in their lower sections. But whilst the Makorum joins the Hispar at a right angle, the Haigatum enters it under a very wide angle giving rise to a splendid bend.

SEKAMBARIS GLACIER.

Farther down the Hispar there exist still a few glaciers, the last two of which are but poorly defined. It was indeed difficult to trace their parting ridge. The Garumbar, which is the lowest, has retreated to a distance of $2\frac{1}{2}$ kilometres from the Hispar, forming a real hanging glacier.

Such are the special features of the present glaciation in

the Hispar basin. We have endeavoured to give as detailed an account of it as possible, noting, step by step, the moraines and snowfields, and penetrating up the main tributaries. Standing now at the pass, where snows exhibit no distinct tendency either way, we may attempt to form a synthetic

PORTION OF DIVIDE SEPARATING KANIBASAR FROM SMALL GLACIER WITHOUT NAME WEST OF IT. View taken from latter glacier.

image of that glacial system which has no equal outside the poles.

The first striking feature is the enormous size as compared with the Alpine glaciers. The Aletsch is but a small thing compared with the Hispar-Biafo. The classical Grindelwald glaciers at most compare with the main tributaries.

Moraines, torrents, and erratics are equally gigantic.

Here, as for all Himalayan glaciers, the lower section is buried under a layer of granite moraine a few metres thick. On the whole it compares with the Norwegian fjords. The horizontal surface of the sea is fairly well represented by

GENERAL VIEW OF THE HAIGATUM GLACIER FROM ITS RIGHT MORAINE—EAST SIDE NEAR HISPAR GLACIER.

the apparently motionless surface of the ice, and the slopes on each side have a similar upright profile.

The whole of the glacier and branches recall the network of a hydrographic system with a trunk and increasingly numerous feeders.

The comparison with an ice-river is, as it were, literally

correct. If the main trunk was partially explored by former observers, they entirely left out the branches that completed its hydrographic and glacial physiognomy.

So far all these features may be found in our Alps. The special characteristic of this and all Himalayan glaciers and valleys is their extreme youth. One may say that the

THE MAKORUM GLACIER.

slopes on either side are in constant motion. Wholesale land-slides, slow gliding motions, local slips, gullies, fan-deposits, torrential and erosive actions reach here a maximum. It will be a long time yet before a relative equilibrium is attained.

The accompanying map and topographical surveys are

the best and most vivid illustrations of these general remarks suggested by the inspection and interpretation of

GARUMBAR GLACIER FROM NORTH BANK OF HISPAR OPPOSITE OPENING OF ITS GULLY.

the ground itself. They may be said to be the first regular topographical work carried out in these districts in the spirit and with the practice of modern methods.[1]

Dr. Cesare Calciati.
Dr. Mathias Koncza.

Freiburg, *June* 1909.

[1] *Vide* also a paper stating the scientific results of the Expedition in the *Bulletin de la Société Fribourgeoise*, 1909.

APPENDIX II

ÉTUDE SOMMAIRE[1] SUR LE MATÉRIEL LITHOLOGIQUE (ROCHES ET SABLES) RAPPORTÉ PAR LE DR. C. CALCIATI DU BASSIN DU GLACIER D'HISPAR (HIMALAYA, N.W.)

(Expédition Bullock Workman, 1908.)

ROCHES

Granit à biotite (c'est la roche prédominante dans toute la région), à grosse graine, composé de quartz, feldspath et biotite brune, à éclat métallique. Le feldspath est représenté par du microcline, un plagioclase acide et de l'orthose qui présente bien évidente la structure vermiculée (Michel-héry), Minéraux accessoires y sont : zircon, tourmaline, sphène et apatite.

Roches de la paroi orientale du glacier du Lak.

Pegmatite grenatifère, micromérique, de couleur blanche, formée de quartz et microcline avec peu d'albite et grenat, rose, abondant.

Fréquentes inclusions de zircon et tourmaline dans le quartz et les feldspaths.

Quartzite, granulaire, à éclat résineux et couleur jaune-rougeâtre.

Gneiss granitoïde à biotite, riche en oligoclase.

Roches du versant N.W. du glacier du Lak.

[1] Voir étude complète : A. Roccati, *Sopra alcune rocce e sabbie del bacino del Ghiacciais Hispar* (Himalaya Nord-occidentale). Padova, Società Co-op. Tipografica, 1909.

Epidosite, aphanitique, de couleur jaune-verdâtre, formée de quartz, épidote et pyrite granulaire.

Schiste micacé à biotite.

Roche formant en partie le versant de droite (W.) du glacier Pumarikish, affluent septentrional de l'Hispar.

Calcaire dolomitique à gros grain et cohésion minime.

Il contient $C_r\ CO_3 = 82,77$, $Mg\ CO_3 = 17,87$, $Fe\ CO_3 = tr.$

Un exemplaire qui provient du glacier du Lak contient du mica blanc ; un autre du talc verdâtre.

SABLES

Sable (à grosse graine, avec trace minime de fluitation) porté par le torrent dont les eaux proviennent d'un petit glacier suspendu et du glacier de Lak. Manque absolument de partie argileuse et de minéraux métalliques.

Est formée par du quartz, de l'abondante biotite à éclat métallique, feldspaths, (microcline, orthose et spécialement oligoclase) ; chlorite, actinote, épidote, zircon, tourmaline incolore, grenat rose.

Sable de la moraine superficielle du second des affluents de droite (W.) du glacier de Lak.

Analogue au précédent comme composition, mais à grains plus fins.

Sable formant la moraine superficielle médiane de la langue terminale du glacier d'Hispar.

Analogues aux précédents, mais contenant des fragments abondants de roche : schiste micacé et granite à biotite ou à deux micas.

Moraine superficielle médiane du glacier de Makorum, affluent méridional de l'Hispar.

Est formée en grande partie de matière argileuse avec débris végétaux. Moyennant un lavage répété on obtient un peu de sable analogue aux précédents, mais où la biotite, comme produit d'altération, présente une couleur jaune d'or à éclat métallique, qui pourrait justement faire croire à l'existence du précieux métal, qui en réalité n'y existe pas.

De nombreux fragments de roches existent dans le matériel : schiste micacé, quartzite, gneiss à biotite grenatifère et sans grenat.

Terrain du cône fluvio-glaciaire où se développent les quelques cultivations du village d'Hispar à environ 3200 m.

Formé dans sa plus grande partie d'argile avec débris végétaux ; contient néanmoins une partie de sable riche en espèces minérales : quartz, biotite, mica blanc, feldspaths, amphibole (actinote, hornblende, arfvedsonite (?)) ; épidote, chlorite, talc, magnitite, tourmaline blanche et noire, grenat, zircon. Y existent aussi des fragments de roches : granit à biotite, gneiss grenatifère, quartzite, schiste micacé et schiste graphitique, qui, n'existant pas dans les autres sables, doit être transporté par le torrent de Yengutsa qui débouche à proximité.

Comme conclusion, on peut admettre que le Bassin du glacier d'Hispar est formé par des roches gneissicom-granitiques, probablement de l'Archaïque, auxquelles sont associés le calcaire et les roches schisteuses qui peuvent représenter des terrains moins anciens.

Dr. Alessandro Roccati,
Professeur au R^e. Politecnico de Turin.

APPENDIX III

EXPÉDITION BULLOCK WORKMAN, 1908
(HIMALAYA)

Plantes recueillies en août sur le glacier d'Hispar :—

Par M. le Dr. CESARE CALCIATI, moraine latérale nord à une altitude de 4700 m.	Par M. le Dr. MATHIAS KONCZA, moraine vivente superficielle à une altitude de 4000 m.
Lichenes.	
**Squamoria rubina*, Wainis.	
Cyperaceae.	
**Carex nivalis*, Booth.	**Carex nivalis*, Booth.
Gramineae.	
	Poa alpina, L.
Liliaceae.	
Lloydia serotina, Reichb.	*Gagea lutea*, Schulz, f. * „ *reticulata*.
Salicaceae.	
	Salix (non déterminable).
Polygonaceae.	
**Fagopyrum cymosum*, Meinn. „ *tataricum*, Gourt.	*Oxyria digyna*, Hill.

Ranunculaceae.

**Ranunculus hirtellus*, Boyle.	

Cruciferae.

Thlaspi alpestre, L.	**Chorispora sabulosa*, Camb.
Cerastium trigynum, Villars.	

Crassulaceae.

Sedum Rhaviala, D.C.	*Sedum Rhadiola*, D.C.

Rosaceae.

**Potentilla argyroplylla*, var. **leucochroa*, Hook.	**Potentilla desertorum*, Byl.
„ *fruticosa*, L., var. **pumila*, Hook.	* „ *sericea*, L.
„ **Salessovii*, Steph.	

Leguminosae.

Oxytropis lapponica, Gand.	

Oenotheraceae.

	Epilobium palustre, L.

Primulaceae.

**Primula nivalis*, Pallas, var. *macrophylla*, Pax. (*P. purpurea*, Boyle.)	
* „ *denticulata*, Sm.	*Primula denticulata.*

Baraginaceae.

Myosotis sylvatica, Hoffn.	

Scrophulariaceae.

**Pedicularis cheilanthifolia*, Sch.	

Caprifoliaceae.

**Lonicera glauca*, Hook.	

Compositae.

**Cnicus arvensis*, Hoffn.	
**Lactuca tatarica*, C. and M.	
Leontopodium alpinum, Con.	*Leontopodium alpinum*, Con.
Erigeron alpinus, L., var. *uniflora*, Hook.	*Erigeron multiradiatus*, Benth.
**Aster heterochaeta*, Benth.	**Aster heterochaeta*, Benth.
	**Chondrilla aff. graminea m.*, Benth.
	**Allardia tomentosa*, Dren.

Les espèces marquées avec astérisque (*) *ne se trouvent pas* dans nos Alpes.

Ces plantes ont été données au Musée Cantonal d'Histoire Naturelle de Fribourg (Suisse), et sont déterminées par Sir A. D. Cotton et Sir S. Y. Hutchinson du Jardin Botanique de Kew.

MAP OF KASHMIR

showing the routes travelled by

FANNY BULLOCK WORKMAN AND DR. WILLIAM HUNTER WORKMAN

during the summers of 1898, 1899, 1902, 1903, 1906 & 1908

Scale of Miles

10 0 10 20 30 40 80

74° 76° 78°

36° 34°

Bar Hunza Nagyr Chalt Hispar Hunza R. Yasin R. Guldpur Pyramid Pk 24500 Mt Lungma Mt Chogo Sinakar Alchori Pk Hisper Pass 17475 Gilghit Mt Haramosh 24270 Domoh Arandu Mt Rachel Ganchen Nangma Tipsar Hoh Hemasil Dollo Hildero Gunto La Tigistan Askole Mustagh P. K2 Baltoro Glacier Korofon Masherbrum Mt Bullock Workman Kuser Gurgo 21000 Skoro La 17000 Siegfriedhorn 18500 Rondu Tango Pir Basho Shigar Olmo Nurbuchung Kande Khorkun Karakoram Pass 18317 Depsang Plains Ksilanger Worchi Sassar Murga Strongstel Changlang Putilak Tiksay Pannamik Chamshing Tsati Thirit Wachan Kharchar Shayok R. Sazin Tor R. Indus Gis Thak Jalkot Kotgali R. Kotgali Nanga Parbat 26620 Astor Khadas Bunnok La Ranga Skardo Kiris Kerko Thagas Abru Shayok R. Ababan Kustong Thang Chuar Turtak Sunido Tiksay Nubra R. Nubra Handangsmin Gurkhun Gudial Ghanul Khaigun Gihar Waitar Dundial Sirdari Kanjalwar Gurais Rajdangan P. 11809 Tragbal Shaltura Pala Mirpur Kishengang R. Muzzaffarabad 2455 Domel Dudial Kindar Chikar Kohala Jhelum R. Chagoti Uri Baramula Woolar Lake Sopor Sumbal Ganderbal Sinnar Kangan Gagangir Gund Sonamarg 11300 Zozi La Baltal Matayan Dras Tashgam Gulturc Shigar R. Duria Shingo R. Mintemarg Burzil Moldar Burzil R. Sara Sanga P. 16200 Stakpi La Deosai Plains Ali Malik ke Mur 13400 Parkutta Bongul Tolti Eharmang Gidiazdo Shiriting Bamachan Hardas Chenegund Kargil R. Indus Tambis Tuinah Kartse Purtik Suru Perkutse Gulmatunga Kangi La 17002 Kangi Fotu La 13446 Lamayuru Saspul Nurla Khalsi Mulbeek Khurbu Laidoh Letsun Chantung Paru R. Tsarap R. Nun Kun Gompa (Lama Serai) Taxi Tonzas Pinnacle 23300 Kardong Pass 17574 Nonu (Sneno) Leh 11280 Sumdah Chiling Shushot Tiksay Shayok Ihabap Chilam Himis Arpa Ikpadok Hankur Hanomil Abring Zuzzar Khurna Kur Khurna Petgam Naubug Harjpur Islamabad Achabal Martand Bchara Murhama Payech Chrar Punch Dhara Sakra Mergan P. 11600 Wardwan Inshin Rikingwas Bhotkol R. Bhotkol 16370 Lidar R. Bhatkot Awantipur Pampur Palgam Srinagar 5765 Sher Garhi Gulmarg Mahadeo 13084 Kolohoi or Gwashbrari 17838 Sind Ara Jhelum R. Murree Dhara Punch Chakoti Tragbal Kanjalwar Gurais Tilail Valley Kishenganga R. Astor R. Kamri R. Indus Valley Kashmir Zanskar Ladakh Baltistan Chorbat Nubra

M.C.

THE HISPAR GLACIER

AND TRIBUTARIES

IN THE

KARAKORAM RANGE

Explored by the

BULLOCK-WORKMAN EXPEDITION 1908

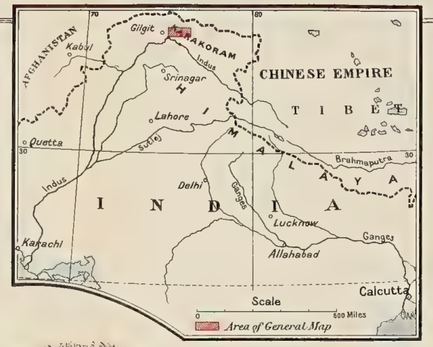
BY

Dr CESARE CALCIATI AND Dr MATHIAS KONCZA

Scale 1 : 100000 or 1 Inch 1·58 Stat. Mile

Kilometers 0 1 2 3 4 5 10

Miles 0 1 2 3 4 5



Reference

- Route of Bullock-Workman party
- , , Calciati-Konicza party
- △ Points determined by Triangulation
- ⊙ Theodolite Stations
- ▲ Pyramids
- □ Camps
- 4680 (15354) Heights in mètres / in feet } from Boiling Point Observations

Note

This map is based on surveys with Theodolite and "Règle à Eclimètre" supplemented by stereoscopic and panoremic photographs and sketches with Camera Lucida

M.C. from the original drawing of Dr M. Konicza

75° 5' 10' 15' 20' 25' 30' 35' 40'

36° S

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NOTE TO MAP

The peak Kunjut No. 1, the highest peak in the region, at the head of the Kanibasar Glacier, triangulated by the Indian Survey at 25,460 feet, and the marginal indications of latitude and longitude, were not noted by Drs. Calciati and Koncza on the original map for reasons stated by them in the text.

These were added by the authors. Kunjut No. 1 alone of the two points fixed by the Indian Survey in the region covered by the map could be identified. The latitude and longitude of the map are referred to those of the position given by the Survey to this peak. According to information obtained from the Survey, a correction of $-2'\ 27{\cdot}18''$ should be applied to its longitude to reduce it to the latest value of Madras, which is $80^\circ\ 14'\ 54''$. The same correction should therefore be applied to all other points of the map.

24-8-64

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